THE MODERN
HOME PHYSICIAN

A COMPLETE GUIDE TO THE ATTAINMENT AND PRESERVATION OF HEALTH

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THE PRINCIPLES AND PRACTICE OF AMBULANCE OR FIRST-AID WORK—*Continued*

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THE MODERN PHYSICIAN

SECTION I

THE PRINCIPLES AND PRACTICE OF AMBULANCE OR FIRST-AID WORK—*Continued*

HÆMORRHAGE, OR BLEEDING, AND THE TREATMENT OF WOUNDS

THE anatomy and physiology of the heart and blood-vessels will be found treated of in the section of this work devoted to the consideration of these organs. It is however necessary, for the purpose of clearly understanding the principles on which *hæmorrhage or bleeding* requires to be treated, that a brief recapitulation of the chief facts connected with the blood-vessels and the course of the circulation should be given in the present instance.

The Circulation.—The heart is a double organ, and might legitimately enough be described as consisting of two hearts joined in one. The *right side* of the heart is occupied exclusively in sending blood to the lungs for purposes of purification. The *left side* of the heart, which is the stronger of the two, is in its turn exclusively occupied in pumping pure blood out through the body. The general course of the blood system is therefore from the left side of the heart, whence we find *pure or arterial blood* sent on its mission of nourishment to the body. This blood propelled by the left side of the heart finds its way through the larger *arteries* into the smaller vessels, and finally reaches the finest blood-vessels of the body (called *capillaries*), which bring the nutritive fluid in contact with the minute cells and tissues of the frame. As the blood passes onwards in the capillaries in every part of our body we find it gradually taken up by vessels of a larger calibre, the *veins*. These vessels join others of still larger size, and in this way we find that the blood has practically completed the round of the body, or in other words has made its "circulation." For whilst it passes out as pure blood through the arteries, and finds

its way into the capillaries, the finest vessels of the body, it ultimately passes into the veins, which in whatever part of the body they are found convey impure (or *venous*) blood back to the right side of the heart.

The Artery and the Vein.—From the foregoing observations we note that an *artery* is a blood-vessel carrying blood *from the heart to the body.* We know also that a *vein* is a blood-vessel performing the opposite function, that of *carrying impure* or *venous blood from the body back to the heart.* The *capillaries*, or finest blood-vessels, form, as we have seen, a connecting link between the arteries and veins, thus maintaining the round or circulation of the blood.

We must next note that pure blood is of a *light red colour.* Venous blood is of a *dark purple colour*, whilst the blood of the capillaries is of a *reddish tint.* It is important to note the difference in the colour of blood, by way of enabling us to distinguish the source from which it comes; that is to say, whether it issues from an artery or vein. Another point of extreme importance in dealing with wounds is that which concerns the manner in which blood flows from the wound of an artery as compared with the manner of its flow from the wound of a vein. An artery being a tube in direct communication with the left side of the heart, *blood will issue from it when wounded in jets*, each jet corresponding with a stroke of the heart-pump. On the other hand, the flow of blood in a vein is not impelled directly by the heart, so that if a vein be wounded *there is no spurting of blood, but a more or less continuous flow or oozing.* We must bear in mind these two important points—namely, the colour of the blood in artery and vein respectively, and the manner of its flow when either vessel is wounded.

The greatest dangers to life in connection with wounds are undoubtedly seen in cases where an artery has been injured. If the blood is coming directly propelled from the left side of the heart, we may readily understand how the wound of an artery even of moderate calibre may speedily prove fatal if the flow be not instantly arrested. In the case of a vein, whilst it is desirable that the hæmorrhage should be arrested at as early a stage as possible, there is not the same immediate danger as that encountered in the case of the wounding of an artery.

"Fingers First."—The general ambulance instruction may therefore be at this stage impressed upon the reader's mind—namely, that when he is face to face with a wound characterised by a flow of light red blood coming in jets or spurts, he must take instant action. That action may be summed up in the expression "Fingers first"—

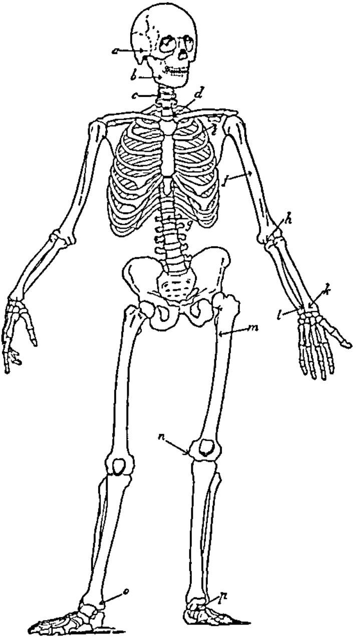


FIG. 1.—Skeleton with points marked where compression of arteries can be made.

at Ankle

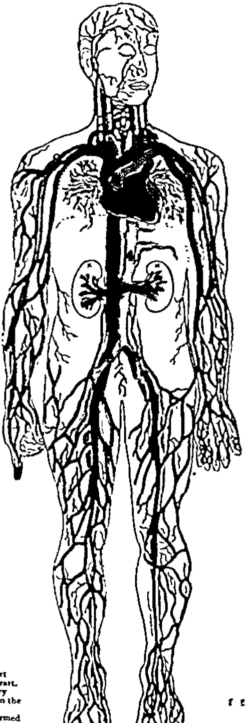
that is to say, *he must at once apply pressure with his fingers between the wound and the heart* in order that the flow may be thus arrested. The common-sense nature of this proceeding is obvious, for if no other assistance is at hand, and if the bystander runs off to seek for a bandage or some appliance by way of arresting the bleeding, the patient would be liable to a serious and probably fatal drain of blood. By the expression "fingers first" we mean to imply that *compression of the wounded artery should be made against the nearest bone.* In the accompanying illustration will be found duly marked on a figure of the skeleton (Fig. 1) the points at which compression of the principal arteries of the body may most readily be made. These compression points will be described in detail. The important feature to be noticed here is, that as the blood in a wounded artery *is flowing from the heart to the body,* the pressure must invariably be made between the wound and the heart. Yet another feature of interest is to be found in the shape of the question, what should be done if no knowledge of the exact point of compression be the property of a bystander? In such a case the blood must be arrested on common-sense principles by making pressure between the wound and heart, and as near to the seat of the wound as possible, when it is more than likely the pressure will naturally affect the blood-vessel that has been wounded. If, however, all other means fail, it would be proper to *place the finger in the wound itself so as to press on the bleeding point.* The leading idea in this practice is to note that rapid loss of blood may prove fatal within a few minutes, and our duty is to secure that the flow be at once arrested.

Wounds of Veins.—In the case of *the wound of a vein,* pressure is to be made first of all on the wound itself. If the wounded vein be of ordinary size this will probably suffice to arrest the hæmorrhage. If, however, the wound be of large size pressure ought to be applied *on the side of the wound furthest from the heart,* seeing that the blood in the vein is returning *to the heart.* In the case of capillary bleeding, where we have a flow from, it may be, a large number of microscopic blood-vessels, pressure directly on the wound will be found to be an effective mode of arresting the bleeding.

General Treatment of Bleeding.—Certain other important points have to be noted in connection with the general treatment of bleeding. Later on, the special treatment to be applied in the cure of those who have suffered from accidents of this kind will be duly detailed. Meanwhile it may first of all be noted, that where a blood-vessel has been torn there will be less likelihood of hæmorrhage than in one which has been cut clean across. In the case of small blood-vessels, as in that of an ordinary simple cut or scratch, nature herself

GENERAL DISTRIBUTION OF THE BLOOD-VESSELS

(The Arteries are shown in Red and the Veins in Blue)



1. The Left Ventricle of the Heart
2. The Right Ventricle of the Heart.
3. Trunk of the Pulmonary Artery
4. The Aorta—the main Artery in the Body
5. The Superior Vena Cava, formed by the junction of the Innominate Veins (6, 6), which return the blood from the Head and Upper Extremities
7. The Inferior Vena Cava, which returns to the Heart ... from the Trunk and ... Extremities.

8, 8 ...

9, 9 ...

The main trunks of the Veins usually ...

arres's bleeding through the process of clotting of the blood, and it should be remembered that it is wise in such cases to follow nature's own teaching. Where a blood clot has formed in the case of a wound it will be wise not to disturb it, all precautions being taken at the same time to prevent any risk to life should the clot be disturbed. These precautions will naturally consist in the adoption of means to otherwise ensure stoppage of the bleeding. In cases of hæmorrhage the rule ought to be observed that *stimulants should be avoided.* This advice rests on the obvious rule that we do not desire to stimulate the heart. Nature again teaches us here, in the case of a person who faints from loss of blood, first, that the lessening of the heart's action tends to limit the danger, seeing that the blood supply will be proportionately lessened through the faint. Again, *the position*

stoppage of bleeding. The heart having in this way been faced with a little additional difficulty in propelling the blood, the patient benefits from the elevation of the part. It might also be noted that in the case of bleeding from veins it will be important to remove all tight articles of clothing, so as to prevent any engorgement of the vein at the seat of injury.

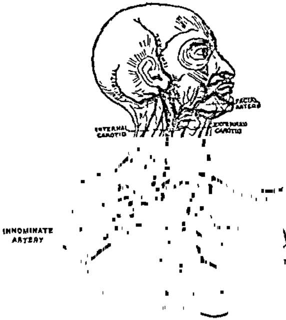


FIG. 2.—Distribution of Arteries in Head and Neck.

Where Arteries Lie.—Bearing in mind these general principles adapted for the treatment of bleeding accidents, we may now proceed to notice the *distribution of the chief arteries of the body.* It will be noted that veins in many cases lie close to the surface of our frames. If a simple demonstration be required in order to impress upon our minds that the blood in every vein is passing to the heart, we only require to grasp the wrist of one arm with the fingers of the other, and to allow the hand thus grasped to remain in a dependent position. The veins of the back of the hand will speedily be seen to swell *below* the fingers which are encircling the wrist, thus proving that we are stopping a current of blood which is flowing *up* the limb. Certain arteries are, like veins, placed comparatively close to the surface of

the body. These arteries can of course be readily affected by the process of compression to which allusion has already been made.

Referring to the illustration (Fig. 1), we may note that practically the distribution of arteries corresponds on one side of the body with that of the other. Arising from the heart in the form of an arch we find the great main artery of the body, called the *aorta* (Fig. 1, *g*). This arches as soon as it leaves the heart, and then runs down the spinal column, forming the main source of supply for the parts of the body below. From this arch we find that blood-vessels pass upwards to supply the head and neck. From the right side of the arch a vessel called the *innominate artery* (Fig. 2) is given off, this vessel being short and lying immediately behind the point where the collar-bone and the breast-bone join on the right side. It separates into two branches. One of these is called the *right common carotid artery* (Fig. 2), which runs upwards into the neck towards the ear of the right side. The other branch turns downwards and outwards, and serves as a main supply for the right arm. In the first part of its course it is called the right *subclavian artery*. It is the *carotid artery* just described, lying as it does in the neck, which mostly suffers when an individual attempts to commit suicide by cutting his throat. This artery in its turn divides into two, and the branches are known as the *external* and *internal carotid* arteries (Fig. 2). The former supplies the jaws, the face, and the scalp with blood by means of the *facial*, *temporal*, and other arteries (Fig. 2), whilst the latter passes upwards, and finally ends through its branches in the brain. On the left side of the neck we find much the same arrangement of the arteries, but the left *common carotid artery* is given off independently from the arch of the *aorta*, as also is the *subclavian artery* of that side.

Turning now to the supply of the arm, and commencing with the *subclavian* artery, we note the *subclavian* (Fig. 4, 1*a*) to pass over the first rib and under the collar-bone; hence it passes naturally into the armpit or *axilla*. Here it is known as the *axillary* artery (Fig. 4, 2 and 9). From the armpit we find it traversing the inner side of the upper arm and lying very close to the humerus or upper arm bone. Here it is known as the *brachial artery* (Fig. 4, 3). Its course corresponds with the seam of a coat sleeve, lying as it does to the inner side of the bone. In front of the elbow we find the *brachial* artery dividing out into two branches. These pass out to supply the forearm, one on each side. One branch runs along the course of the *radius* bone, which lies to the thumb side of the arms when the palm is kept upwards. It is the *radial artery* (Fig. 3, 8) which we feel beating at the wrist on the thumb side in the

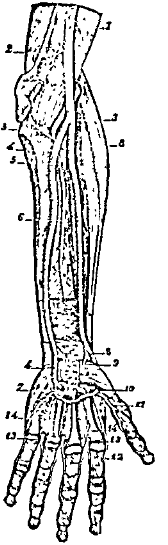


Fig. 3.—Arteries of the Fore-arm and Hand.

1, Brachial Artery; 2, Collateral Branch; 3, Division of the Brachial Artery; 4, 4, Ulnar Artery; 5, Interosseous; 6, Anterior Interosseous; 7, Connecting Branch; 8, Radial Artery; 9, Palmar part of Radial; 10, Deep Palmar Arch; 11, Thumb Artery; 12, Index Finger Branch; 13, Terminal Arteries of Fingers; 14, Branches called Interosseous.

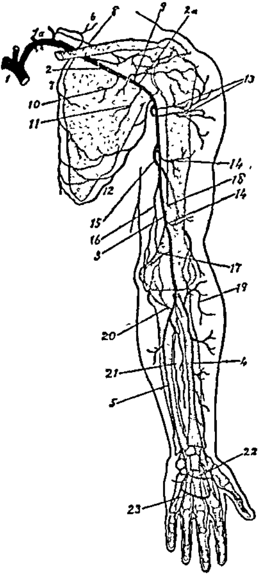


Fig. 4.—Distribution of Arteries in the Upper Limb.

Arch; 23, Superficial Palmar Arch; 15, Profunda Artery Superior; 7, Posterior Scapular Artery; 12, Subscapular Artery. (The other figures refer merely to branches of the main arteries detailed.)

situation in which the pulse is generally felt. The other artery, the *ulnar artery* (Fig. 4, 4), lies somewhat more deeply. At the wrist the two arteries pass into the palm of the hand, and there form two arches (Fig. 3, 10, and Fig. 4, 22, 23) from which the fingers are duly supplied. A fairly large branch given off from the arch supplies the ball of the thumb (Fig. 3, 11).

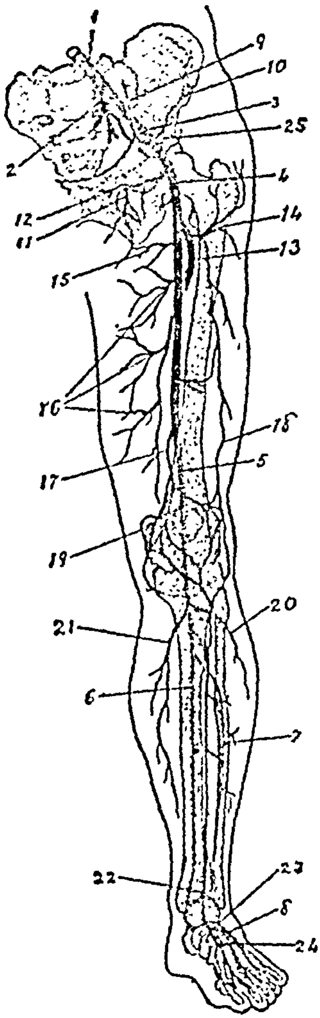


Fig. 5.—Distribution of the Arteries of the Lower Limb.

1, Common Iliac Artery; 2, Internal Iliac; 3, External Iliac; 4, Femoral Artery; 5, Popliteal Artery (continuation of Femoral) passing to the back of the knee; 6, Posterior Tibial Artery; 7, Anterior Tibial Artery; 8, Dorsal Artery of Foot; 15, Femoral Artery (upper part of course); 13, Profunda Artery; 23 and 24, Branches supplying Foot. (The other figures refer to branches of these main vessels.)

Arteries of the Trunk.—With regard to the *trunk of the body*, it has already been mentioned that the *aorta* (called the *descending aorta*, as it passes down the spine) forms the main line of supply for the frame. In its passage it gives off arteries which supply the spaces between the ribs. Below the chest branches are given off, carrying blood for the nourishment of the digestive organs. When we get to the level of the fourth *lumbar vertebra*, that is the fourth of the loins, we find this main blood-vessel dividing in two, its branches being here known as the right and left *common iliac* arteries (Fig. 5, 1). Each of these arteries resembles the other in its distribution. In transit the *iliac artery* turns towards the leg it is destined to supply with blood; but before entering the leg it again divides into the *external* (Fig. 5, 3) and *internal iliac* (2) arteries. The internal vessel supplies the pelvis or haunch with blood, whilst the external branch of the artery leaves the abdomen at the top of the thigh, that is at the groin, and is then known as the *femoral artery* (4), or that of the thigh. At this point on its entrance into the thigh the *femoral artery* can be felt pulsating quite distinctly. For a very short distance it remains to the front of the thigh. It then turns towards the inner side of the thigh, and is found at the back of the thigh-bone, passing down-

wards to the back of the knee-joint, where we find it called the *popliteal artery* (5). This artery lies in what is called the *ham space*, or that at the back of the knee. Passing from this space downwards, the artery divides in two, just as the *brachial artery* in the arm exhibits a similar division. The two branches pass downwards in the leg, one in front of the shin-bone and the other behind it. The one in front is called the *anterior tibial artery* (7), while that behind is termed the *posterior tibial artery*. At the ankle the *anterior tibial* vessel is found at the top of the instep in front, while the *posterior tibial artery* (6) enters the foot at the inner side of the ankle. This latter vessel passes into the sole of the foot, and, dividing, forms an arch for the supply of the toes (23 and 24).

Compression Points.—Keeping in mind these details, it will be an easy matter to note the *chief points in the body at which compression for the arrest of arterial bleeding may be readily applied.* These points are duly indicated by arrows on the accompanying plate of the skeleton (Fig. 1). Thus bleeding in the head or neck may be controlled by pressing the *common carotid artery* (Fig. 6) on either side against the spine. The pressure here should be made by

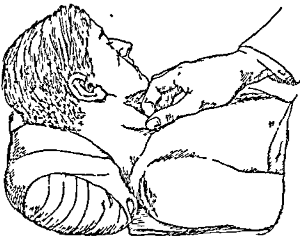


FIG. 6.—Compression of Carotid Artery.

the thumb, and should be directed inwards and backwards behind the windpipe, the situation in which the pressure may be most effectively applied being on or about a level with the larynx, or organ of voice. In this way bleeding from a wound anywhere above in the head or neck may be controlled. Naturally, however, when we turn to the head itself, we find that if bleeding takes place from any artery supplying the scalp or covering of the skull, we have a ready means of arresting such bleeding, seeing that, by pressing at or near the bleeding point, we have everywhere below our finger a bony case against which pressure may be readily made. With regard to wounds of the face, pressure may be made on the *facial artery* (Fig. 2), which is the main vessel supplying the face with blood. This artery curves over the edge of the lower jaw in front of the angle of the jaw, and it may readily be felt beating by placing the finger in the situation just indicated. Another useful point for the control

of bleeding is that by which we arrest hæmorrhage in the neck itself. In a case, for example, of any injury to the *carotid artery*, it is obvious we must apply pressure below the wound, that is, between the wound and the heart. A ready means of doing this is found by compressing the *subclavian artery* (Fig. 7) against the first rib on which it lies. If we place the thumb in the angle formed by the union of the collar-bone and the top of the breast-bone, in that hollow of the neck which children are accustomed to call "the bird's nest," we may compress the artery against the rib, arresting bleeding anywhere above. In this case we stand behind the patient's shoulder and make pressure with the thumb. By relaxing the shoulder through pushing it somewhat forwards the artery can be more readily reached. It need hardly be said that the compression of the *subclavian artery* is the proper means to be adopted in arresting what is always a dangerous accident, namely, wound of the axillary artery in the armpit.

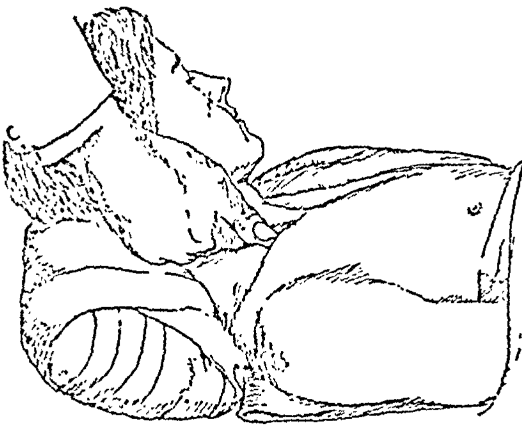


FIG. 7.—Compression of Subclavian Artery.

In the upper arm the *brachial artery*, whose position we have seen roughly to correspond with the seam of a coat-sleeve, lying as it does to the inner side of the *humerus* or upper-arm bone, can be easily compressed against the bone at any part of its course (Fig. 8). This artery, it will be understood, is a direct continuation of the axillary artery. It may, however, be noted with reference to this latter blood-vessel that, in a wound of the armpit which involves the axillary artery, if it be found for any reason impossible to compress the subclavian artery as already described (Fig. 7), it would be proper to place the finger in the wound directly on the bleeding point of the artery, so that the artery might practically in this way be pressed against the shoulder-blade (Fig. 4, 2). Compression of the *brachial artery* in the upper arm, as just described, will be necessarily adapted to arrest bleeding anywhere below the point at which compression is made. It might thus be used to arrest hæmorrhage in the lower part of the upper arm, in the forearm, or in the hand.

Compression in Forearm.—A much preferable method, how-

ever, for checking bleeding anywhere below the elbow is that of compressing the artery in the space in front of the elbow (Fig. 3, 3). The method about to be described is extremely useful not merely in wounds of the forearm, but likewise in injuries to the hand involving hæmorrhage. Where a large number of bleeding points have to be secured, such as may be represented in the case of a gunshot wound of the palm of the hand, we act here on the principle of "cutting off the supply at the main." Place a pad or rolled-up bandage in the space in front of the elbow, keeping the forearm extended with the palm uppermost. Next bend the forearm on the upper arm. By this act the pad will be pressed firmly into the hollow, and thus compress the blood-vessel. Next turn the palm of the hand forwards whilst the forearm is bent on the upper arm, and tie the forearm to the upper arm with a bandage, keeping the limb elevated. In this way hæmorrhage anywhere below the elbow can be easily checked. Other points at which compression may be made in the upper limb are situated in the wrist. We have seen that the *radial* and *ulnar* arteries pass respectively down the wrist one to each side of the limb. As each of these arteries practically lies on a bone, it is a very easy matter to arrest the supply of arterial blood to the hand by compressing these two arteries at the wrist with one's thumbs (Fig. 3). Occasionally, where wounding of the palm of the hand has taken place, a situation in which, as we have seen, there is a very full supply of arteries, hæmorrhage may be checked locally by filling the palm of the hand with a firm pad, and binding the fingers over the pad so as to exert compression on the palm. Thereafter the arm should be placed in a sling, and the hand elevated, so that it may rest on the opposite shoulder; but for safety compression may also be made higher up in the arm as already described.

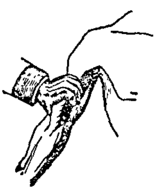


Fig. 8—Compression of Brachial Artery.

Compression in Trunk and Leg.—Turning now to the trunk, it will readily be understood that it is a somewhat difficult matter to arrest bleeding when any large artery has been wounded in any of the cavities of the body. The only direction that is available for the ambulance student here is to note that in thin persons the clenched hand can be used to exert pressure on the *aorta* against the spine (Fig. 1, *g*). This method, indeed, has been recommended for the arrest of hæmorrhage in women in connection

with childbirth. The umbilicus or navel may be selected as the most likely spot where pressure may be applied effectively.

In the case of the lower extremities, we find that bleeding from any wound of the middle or lower part of the thigh can be very efficiently checked by compression of the *femoral artery* against the thigh-bone at its upper part (Fig. 5, 4). It will be remembered that this artery only comes to the front of the thigh in the upper part of its course. The thigh should be encircled with the two hands, and the ends of the thumbs used to make efficient pressure on the vessel (Fig. 9). Here, of course, again, on the principle of cutting off the supply at the main, we may check bleeding occurring anywhere below this situation in the leg. If any need exists to render this compression of the artery in the thigh of a more permanent character, a pad may be placed upon the *femoral artery*, and the thigh in its turn bent forcibly upwards on the abdomen. The thigh should be secured in this position by a bandage. This plan would be specially serviceable in the case of wounds involving the lower part of the thigh.

FIG. 9.—Compression of Femoral Artery.

At the *ham space* (or that at the back of the knee) the same mode of efficiently checking bleeding anywhere below in the leg can be practised that we noticed in connection with the compression of the artery at the elbow. A pad should be placed in the ham space, the leg being bent backwards on the thigh, so as to compress the pad. It is probable that the ambulance student will find this latter mode the most effective for checking bleeding anywhere below the knee, for the reason that, as the arteries of the leg are somewhat deeply placed, and difficult to find by an amateur, the more efficient practice is that just described. In the case of wounds of the feet, it will be found that this practice will also be available, but where, say, arteries in the sole of the foot have been wounded through that very common accident, stepping upon glass, local pressure applied directly to the bleeding points in the foot may suffice to arrest the hæmorrhage. At the same time, we may repeat it as a much more scientific and effective practice to check the blood supply higher up in the limb by compressing a main artery.

Tourniquets.—Having thus arrested arterial bleeding immediately by compression of the vessels, and having thus prevented further loss of blood, our next duty is that of rendering the arrest of the

hæmorrhage more or less permanent until surgical assistance can be obtained. It must never be forgotten that *the instant arrest of arterial bleeding* by pressure is the first duty of the ambulance student. Having secured that no further loss of blood takes place, he may proceed to place the patient outside the reach of immediate danger through the use of an instrument called a *tourniquet* (Figs. 10, 11). This name is derived from the French verb meaning "to turn" or "to twist." The term is derived from the fact that it was a French army surgeon Morelli who, in 1674, invented this apparatus for checking bleeding resulting from wounds. The earliest tourniquets

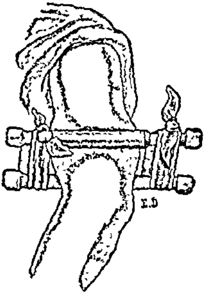


FIG. 10.—Tourniquet made of two sticks with compression by bandages.

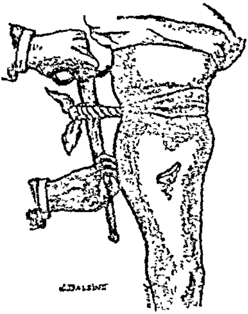


FIG. 11.—Extemporised Tourniquet applied to Femoral Artery.

used present essentially the same features which are seen in all modern instruments. In the simpler varieties of these instruments we find three things included. There is first a *bandage*, by means of which compression of the artery is effected. In the second place, we find a *pad* of some kind, which can be applied directly to the blood-vessel, so that the compression may be made effective. In the third place, we require to be provided with *means for twisting the bandage*, so as to exercise any needful amount of pressure. There can be no better demonstration of a simple tourniquet than that which can readily be improvised by using any kind of bandage ranging from a necktie, a handkerchief or towel, a brace, a cricket belt, a leather strap to a woman's stocking, or a strip taken from

the border of a dress. A small piece of cork or wood, or even a pebble from the road, placed within this bandage would represent the pad. This would be placed over the artery which it is desired to compress. A piece of stick would represent the twisting mechanism, and this taken up in a loop of the bandage could be used to twist the latter to exercise any degree of pressure. Here we simply imitate the manner in which a carter uses a rack pin to render tense the rope which secures the barrels on his cart (Fig. 11). The end of the stick, of course, could be easily tied in position, or might even be slipped under the edge of the bandage itself.

It can readily be seen that a tourniquet consisting of the three parts just described may be made or constructed of very plain materials (Fig. 10). An ordinary strap with a pad attached to it, capable of being drawn tight and buckled to a limb, might serve adequately for the purpose of checking hæmorrhage. *Elastic band* tourniquets, as they are called, were invented by Professor Esmarch of Kiel, who attained distinction as a German surgeon in the Franco-Prussian War. Elastic bands are used, and these are wound around the limb to any degree of tightness, the ends being duly secured, so that practically the limb is depleted of its blood. The elastic tourniquets just described can, of course, be obtained from any surgical instrument maker.

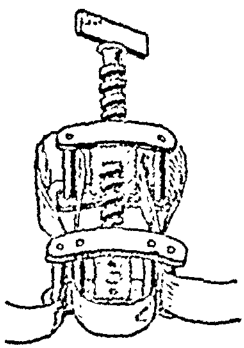


Fig. 12.—Petit's Tourniquet.

Petit's Tourniquet.—A tourniquet which is of great service, because the pressure to be exercised can be easily graduated to any degree, is that known as "Petit's Tourniquet" (Fig. 12). This tourniquet may be described as consisting of two brass plates connected by a screw. Between these plates a bandage or strap is run, the ends depending from the plates. On the upper part of the strap a pad, which can be slid to any particular point, is connected The strap is buckled round the limb, and the pad duly adjusted to the artery it is intended to compress. In starting the two plates of the tourniquet are placed close together. By turning the screw, and by the consequent separation of the plates pressure is immediately exerted, and, as has been said, the pressure can be easily increased or diminished at will. Naturally a tourniquet of this kind requires a little experience in its application. It is therefore, perhaps, less adapted for ambulance work than the simpler tourniquets which have just been described.

About relaxing Pressure.—A point of some importance in connection with the arrest of arterial bleeding is that which con-

cerns our duty when, having arrested the bleeding, the aid of the surgeon is delayed. It can well be understood that the application of the tourniquet may tend to arrest *completely the circulation* in the limb, and therefore in a very short time the patient will probably complain of soreness in the limb whilst it will become cold through the deficient supply of blood. In supposing the case of a patient who has to wait a long time before a surgeon arrives, the rule may be followed that after a certain time the tourniquet may be *slightly relaxed*, so as to permit of a certain flow of blood into the limb. It is, however, absolutely necessary that if this procedure be adopted *the tourniquet should never be slackened to an extent such as will render it impossible quickly and at once to tighten it and repress any bleeding which may occur.* By relaxing and if necessary retightening the tourniquet from time to time, so as to permit of a certain supply of blood to the limb, a person may be kept fairly comfortable pending the arrival of surgical aid.

Venous Bleeding.—With regard to *bleeding from veins*, we have already noted the rule that pressure should first of all be made on the bleeding point by means of a pad and bandage. If a very large vein has been wounded, pressure may also be applied *on the side of the wound furthest from the heart*, seeing that in all veins the blood is being returned to the heart.

Styptics.—Also, in respect of wounds of veins, in addition to pressure by means of a pad, it may be necessary to use some form of *styptic*. By this treatment we mean any substance which tends to control hæmorrhage. Examples of *styptics* are found in the shape of oil of turpentine and creosote. Each may be used simply by daubing it on the wound by means of a pad of lint. Sulphate of copper and sulphate of iron are also useful *styptics*, and may be used in solutions of varying strengths. Crystals of either substance may be found an extremely useful application used to the socket of a tooth which shows persistent hæmorrhage. Alum and tannin used in powder are also employed in the checking of bleeding. Nitrate of silver or ordinary caustic is also a useful application for the stoppage of persistent bleeding from small wounds such as the bites of leeches, whilst it is also used for the purpose of cauterising poisonous wounds, represented, say, in the case of dog bite. Collodion is another substance which, in the case of small wounds, has a power of arresting bleeding and of bringing together the edges of a wound. It is especially useful in cases of wounds of the face, in which it is not advisable to place stitches, for the purpose of avoiding the development of any scar. Three or four layers of collodion are painted over the wound by means of a camel's hair brush. The collodion rapidly dries and forms a kind of skin

covering. What is known as *flexible collodion* is made by mixing six ounces of ordinary collodion with two drachms of Canada Balsam and one drachm of castor oil. This is frequently employed in place of ordinary collodion. Cold itself is a very powerful form of styptic. Tincture of iron and Hazeline are also much used for the purpose of checking bleeding, and appear to exercise a distinct effect on venous bleeding. Pledgets of lint dipped in either substance are applied to the wound, pressure being made by a pad bandage. *Ruspini's styptic*, which is a preparation of gallic acid, sulphate of zinc, spirits, and rose water, has long enjoyed a very high reputation for its power of checking bleeding. It can be applied as in the case of other styptics on a pledget of lint or cotton wool. It may be here noted as a matter of fact that whilst warm water encourages bleeding, really *hot water*, that is, water of a high temperature, tends to contract blood-vessels and to stop it. This latter hint may be kept in mind in cases especially where bleeding from a large surface takes place. Styptics mostly act by inducing *coagulation* (or clotting) of the blood, inasmuch as they produce thuswise a mechanical obstruction to the free flow of blood from a blood-vessel.

Cobweb Dangers.—One important caution may here be given in the shape of the advice that *on no account must cobwebs ever be used for the purpose of arresting bleeding.* Spider's webs are frequently used in the country for this purpose, and act through tending to induce the formation of a clot. It should be noted that this practice is fraught with great danger. The essential feature of the treatment of all wounds is that of preserving their absolute cleanliness and freedom from contamination by dirt. As cobwebs are laden with dust, we can readily understand that their application to a wound is simply tantamount to affecting it with the germs. It may be added that cases of *lockjaw* or *tetanus* have arisen from this filthy practice of placing dust-laden webs on wounded surfaces. For an effective method of checking capillary bleeding or that from the smallest vessels of the body, we may mention that vinegar, pure or diluted with water is useful, whilst spirits of any kind, or even scent, may sometimes be employed by way of arresting troublesome bleeding, especially from blood-vessels of small size. Pressure for the most part suffices to check bleeding of capillary nature.

Ligatures.—It may be added that the practice of the surgeon in dealing with an artery which has been divided is that of tying a ligature around the end of the artery from which the blood is issuing. This might be done in the case of extreme emergency, provided the fingers of the operator are rendered aseptic, that is, free from

all contaminating matter. The use of a silk ligature is preferable to any other kind, and the ligature itself should be steeped in a disinfectant solution, say of carbolic acid. Another mode of stopping arterial bleeding is that of grasping the cut end of the artery by means of a pair of forceps and twisting it, so that the muscular fibres of the vessel, in their turn stimulated by the tension, keep the bleeding end permanently closed. Another method of stopping arterial bleeding is known as *acupressure*. This is a method which might be in a case of emergency practised where the services of a surgeon could not be obtained. It consists in passing a clean needle through the skin over the artery and through the skin on the opposite side. In this way the artery is practically compressed by the needle, the object of such procedure being that of arresting the flow of blood from the cut vessel, and at the same time of permitting the blood to flow to the limb through the uninjured blood-vessels.

Transfusion.—In cases where great loss of blood has been sustained, and where the patient may appear to be in imminent danger of death from hæmorrhage, *transfusion of blood* may be resorted to. This procedure, which can only be carried out by medical men, consists in drawing blood from a healthy person by means of a special apparatus and injecting it into the blood-vessels of the patient. It may also be noted that where great collapse from bleeding has taken place, a solution of salt and water is frequently injected into the veins by the surgeon. This solution possesses a wonderful power of renovating the blood supply temporarily, so as to enable the patient to overcome the effects of the shock he has sustained.

SPECIAL FORMS OF BLEEDING

Internal Bleeding.—Under the head of internal bleeding we proceed to consider hæmorrhage from any of the cavities of the body. Bleeding from the mouth, the nose, the lungs, and stomach fall to be considered under this head. With regard to *bleeding from the mouth*, this may result directly from the wound of some blood-vessel in that cavity. Wherever arterial bleeding takes place in the mouth we find naturally the same symptoms which we have seen to characterise the wound of an artery in any part of the body. The blood will be of a light red colour, and it will come from the wound in jets. Here the ambulance student must get the patient to open his mouth in front of a bright light. Having previously washed out the mouth with tepid water, and thus ascertaining the bleeding point, he places his finger thereon. Direct compression of the blood-vessel

is thus the only rule applicable in cases of the kind under discussion. A little ingenuity may enable the person who is affording assistance to apply pressure by means of pieces of cotton wool soaked in tincture of iron, or other styptic.

Bleeding from a Tooth-socket.—Included in the subject of bleeding from the mouth we find a very troublesome condition occasionally represented in the shape of a constant oozing taking place *from the socket of a tooth* which has been recently extracted. This form of hæmorrhage is apt to be specially dangerous if it continues, for it may be some days, seeing that the person is much weakened thereby. The common mode of treating bleeding of this kind is by pressure, made by placing a plug of cotton wool soaked in tincture of iron, hazeline, or other styptic in the socket of the tooth. This method, however, very frequently fails to arrest bleeding, for a very obvious reason. If the pad of cotton wool be of such a size that it merely fills up the top of the socket, it does not in such a case press upon the bleeding point, which will probably be situated at the bottom of the socket. Hence the proper procedure to be adopted here is to take a very small portion of cotton wool, and to press this first of all firmly down into the socket. Above this a larger piece should be placed, and finally a still larger piece so as to completely fill up the socket by a graduated series of plugs. The main point is to exercise pressure directly on the bleeding point. If the directions here given are carried out effectively, such cases may be satisfactorily treated.

Nose Bleeding.—*Bleeding from the nose*, medically known as *epistaxis*, very often proves a somewhat troublesome accident. Where it occurs frequently a medical man should be consulted, seeing that there is probably some derangement of the system which may require a tonic or other treatment, or there may be some local condition demanding attention. Where it occurs only occasionally it may, however, be a somewhat alarming event. In treating bleeding from the nose, the first care is to prevent the patient, as he may tend to do, from leaning over a basin, seeing that the dependent position of his head will favour the continuance of the hæmorrhage. He should be placed on a couch with the head raised and slightly thrown back. Pressure should be made on the root of the nose by the fingers and maintained for some time, whilst cold should be applied to the nape of the neck in the shape of an ice-bag or cold water cloths, a little vinegar being added to the water. The old-fashioned remedy of allowing a door-key to slip down the patient's back for the cure of nose-bleeding probably represents a perfectly scientific practice, inasmuch as the shock produced by the

cold key traversing the spine exercises a nervous influence which we may consider adapted to promote contraction of the blood-vessels. All tight clothing must be removed from the neck, and the arms may be held above the head. The patient should be kept naturally in a cool place. Various substances may be applied directly to the nose. One of the best of these substances is tannin or powdered galls. Sometimes menthol snuff has also acted admirably in checking nose-bleeding. Vinegar and cold water, or water in which a little alum has been dissolved, may be sniffed up the nostrils, or might be injected by means of a syringe. If these means fail to arrest the bleeding the nostril should be plugged with cotton wool. If the bleeding be of a very serious character, the doctor will probably plug the hinder nostrils, that is the opening of the nostrils into the back of the mouth.

Bleeding from the Lungs.—*Bleeding from the lungs* is a common symptom in subjects of advanced lung troubles, amongst them being of course consumption itself. Wherever bleeding takes place from the organs of breathing the physician's services must be at once requisitioned. The symptoms of lung-bleeding are found in the usual presence of a cough, whilst the blood which is brought up is *of a light colour, and is mingled with froth.* Where these symptoms are apparent, the patient should be placed in a cool room, and his head and shoulders raised. Absolute quiet must be enjoined, and the patient prevented from making any movement. Pieces of ice should be given him to suck, whilst cloths wrung out of cold water and vinegar may be applied to the chest. Internally a teaspoonful of hazeline may be given every half-hour or so, whilst vinegar and water is another remedy frequently used. Spirits of turpentine given in milk in a dose of fifteen drops is a third remedy often prescribed in such cases. Smelling salts may be applied to the nostrils by way of exciting what is called "reflex action" as regards the lungs. In such cases it is advisable to avoid giving stimulants of any kind, unless the patient is in a state of absolute collapse, when a teaspoonful of brandy diluted with water may be cautiously given at intervals. If there is much shock, warmth should be applied to the feet.

Stomach-Bleeding.—In the case of *bleeding from the stomach,* we find an accident which is often popularly spoken of as "vomiting of blood." Here again remember that bleeding from the stomach is to be regarded as a fairly serious symptom. It will probably indicate that disease of the stomach exists, such cases often being of a serious character. The blood which is brought up from the stomach will, as a rule, be *found dark coloured, and instead of being*

frothy, as is the case with blood brought up from the lungs, it will, as a rule, be clotted. If it is found mixed with particles of food, the diagnosis is then rendered certain. The remedies for bleeding from the stomach are practically those which have been already recommended for use in the case of bleeding from the lungs. Ice should be given the patient to suck, and vinegar or spirits of turpentine may be administered as already indicated.

Leech Bites.—As leeches are still occasionally used for the purpose of drawing blood from any part in cases of inflammation, it is necessary to note the treatment to be adopted in cases where a persistent bleeding follows the falling off of the animal from the part. A leech has three teeth arranged in a circle. Each tooth makes a separate bite, the three incisions meeting in the centre. The bite of a leech, viewed from one aspect at least, is therefore of a Y-shape. Such a bite is very effective for the easy drawing of blood, considering that practically it exhibits three flaps which fall away from a common point in the centre where the bites meet. It need hardly be remarked that no leech should ever be pulled off the surface of the skin. It should be allowed to satisfy itself, seeing that the quantity of blood it removes is of comparatively small amount. If the leech be forcibly pulled away, the chances are that the teeth may be left sticking in the wound. When a leech has dropped off, and when persistent bleeding seems to occur, as may be the case where the animal has tapped a vein, the bleeding may usually be checked by the application of a pad of lint firmly fixed to the part by means of a bandage. If simple pressure of this kind fails to arrest the bleeding, a dressing of lint or common wool dipped in tincture of iron or hazeline may be first applied to the wound, and then covered by a pad and bandage as described. An important caution to mothers, and indeed in all cases of the application of leeches, is found in the advice that after leeching, especially in children, the patient should be watched in order to see that the bleeding entirely ceases. A child put to bed after being leeched, under the idea that bleeding had stopped, may suffer considerable loss of blood if the bites continue to discharge the vital fluid.

Varicose Veins.—Special attention must be directed in connection with the subject of bleeding to the ambulance treatment of *varicose veins*. These occur in persons whose avocation compels them to remain for long periods in an erect position. Waiters, railway porters, washerwomen, and others are apt on account of their long periods of standing to suffer from this affection. Owing to the existence of some obstruction to the return of blood upwards in the veins of the legs, the veins get extremely enlarged, and when

looked at can be seen frequently as twisted masses of vessels lying beneath the skin. It occasionally happens that, in consequence of some injury to the leg or from some other cause, an ulcer or sore forms on the vein. When this ulcer or sore attains a certain degree of development, and when in its turn it suffers some injury, such as from a blow, the vein is opened and bleeding takes place. This bleeding, as has been described in the case of veins, is of an oozing character, and may take place to a considerable extent without the patient being aware thereof. It is thus no uncommon thing to find a policeman on duty suddenly aroused to the fact that a varicose vein has burst in his leg by feeling the blood trickling down into his boot, whilst a tramp thus affected may collapse by the roadside, and be found in a blanched and unconscious position owing to the loss of blood. The treatment here would be to place the patient in a position with the head and shoulders somewhat elevated. Attention must at once be directed to the stoppage of the flow of blood which, in the case of an enlarged vein, may be of considerable proportions. A bandage should be placed below the wound or ulcer by way of checking the upward flow of blood, but it is of extreme importance to note in this case that a bandage *must also be placed above the wound*, for the reason that a flow of blood from a varicose vein also takes place from above. This is due to the fact that the valves of the veins which prevent any back-flow in a healthy person have been destroyed in the subject of varicose veins. It is important, therefore, to bear in mind the caution that every case of a burst varicose vein must have pressure applied both below and above the wound.

WOUNDS AND THEIR TREATMENT

The proper treatment of wounds forms a very important part of the instruction of the ambulance student, for the reason that, if a wound seen soon after its infliction be properly dressed, much subsequent pain and danger may be avoided. In any case, the work of the doctor is thus prepared for by prompt attention to the wounds of the injured person. It may be said that the primary condition represented in the treatment of all wounds is summed up in the one word, *cleanliness*. Viewed from a scientific standpoint, this term practically means first the removal from the wound of all particles of the nature of "dirt," such particles including germs, many of which are liable when they have gained admittance to the body to produce serious consequences in the way of suppuration and

blood poisoning. The principles thus indicated are really those represented in what has been called the *antiseptic system of surgery*, with which the name of Lord Lister is so prominently associated. Left to itself, and free from any risk of contamination by microbes or germs, an ordinary wound heals by what the surgeon calls "first intention." The process of healing in this case proceeds in what may be described as a perfectly natural fashion without the presence of suppuration, by which latter term we mean to indicate the formation of *matter* or *pus*. If the student will therefore clearly bear in mind that the first consideration is to secure the efficient cleanliness of the wound by thoroughly washing it and cleansing it, aided by the application of appropriate dressings, he will have realised the most important point involved in this part of his duties.

Varieties of Wounds.—For ordinary surgical convenience, wounds have been classified according to their nature, and it is of some importance to note this classification, inasmuch as the treatment of one wound may slightly differ from that applicable to another. The common classification of wounds is that which divides them first into *incised wounds*, a simple clean cut with a knife representing this variety of injury. In the second division are included *lacerated wounds*. Here we find there has been some *tearing* of the parts, and instead of having a wound with clean cut edges, we find its margins are of a somewhat ragged nature. A lacerated wound is well represented by the tearing which might result from a machinery accident. In some cases, also, the bites of animals will inflict a wound of a lacerated character. The third variety of wounds includes those termed *contused wounds*. The contused wounds are, as a rule, caused by blows. The wound shows unevenness at its edges, but, in addition, there is a greater or lesser amount of bruising present. A blow from a policeman's baton or similar instrument will frequently cause a wound of this kind, as also may a fall against any object. A fourth variety of wounds includes those which have been termed *punctured wounds*. The chief character of this latter variety is that they exhibit some depth. What is properly termed a "stab" would represent a wound of this description. These latter wounds are apt to be extremely dangerous, when, as in the case of a stab with a knife or dagger, they penetrate into a cavity of the body, whilst they may also be extremely dangerous when they divide an artery in a limb. The amount of bleeding which takes place from wounds varies naturally with the description of injury. The wounds which will bleed most freely are the incised wounds, whilst, of course, a punctured wound involving a large blood-vessel will also exhibit a large amount of hæmorrhage.

germs, that it is not poisonous if it is absorbed, that it does not irritate the tissues, and that it is relatively cheap. He recommends for recent wounds that one part of izal should be added to eight hundred parts of boiled water. Where a stronger solution is desired, from two or three parts to the eight hundred of water may be employed. If none of the substances in question are at hand, by way of making an efficient antiseptic sufficient for the dressing of a wound, certain other substances may be used. Thus common salt might be employed in the proportion of a dessert-spoonful to a large tumblerful of warm water. Turpentine also forms an excellent application to a wound, and, it should be noted, may be also applied to cleanse the uninjured skin around the wound. Vinegar and water used in a fairly strong solution might also be used if no other fluid is at hand, and even alcohol, in the shape of whisky or of methylated spirit diluted with its own bulk of water, makes a lotion which, in the absence of anything more efficient, may tend to promote the healing process and the destruction of microbic life.

Having thus thoroughly cleansed the wound pending the arrival of the surgeon, a perfectly clean piece of lint or linen rag, dipped in the antiseptic water solution already mentioned, should be laid over the wound. This may be covered with oiled silk, so as to keep the dressing in its place. A bandage should then be applied over all, and in this way the wound will have been properly treated before the doctor comes.

Further Wound Treatment.—Supposing, however, that an injured person is far from medical aid, it would be the duty of the ambulance student to proceed somewhat further in his treatment of a wound. If the wound, after being properly cleansed, is to be placed in a condition for ready healing, it is obvious that the edges of the wound must be duly brought together. This may be effected in various ways. If the wound is of a minor character, strips of sticking-plaster may be used by means of bringing the edges as closely together as possible. This strapping should be kept narrow in the middle, but with broad fiddle-shape ends, in order that a firm hold of the skin may be taken at the ends of each strip of plaster, thus maintaining the edges of the wound in close contact. In some cases a strip of antiseptic gauze may be placed along the edges of the wound so as to prevent the plaster from coming into actual contact with the edges. Surgeons mostly proceed on the principle, to use an emphatic phrase, that it is better to err on the side of doing too little than too much in the way of securing exact closure of a wound, and this even at the risk of incurring a little further delay in the process of healing. The idea

of the surgeon here is that if it should so happen that, despite all his efforts, there may remain in the wound any microbes likely to cause suppuration, the *matter* or *pus* which may be formed can thus more readily escape from the wound.

Sutures.—Other modes of closing wounds where the application of strips of plaster may not be regarded as sufficient are represented by what are known as *sutures*. These practically represent threads of various kinds composed of silk or of some other material. They should be carefully disinfected before being used, and the ambulance student, by the aid of a surgical needle, or even an ordinary needle, may succeed in passing the needle through the sound skin from one side of the wound to the other, and in thus bringing the edges together by tying the thread to one side of the wound. Another useful mode of bringing together the edges of wounds is that of passing needles from one side of the wound to the other, so as to transfix it. Silk is then twisted in a figure-of-8 fashion over the ends of the needle, so as to bring the edges together. According to the depth at which the needles are made to transfix the wound, so the amount of pressure will be graduated to bring not merely the superficial parts of the wound but the deeper parts also together. The pointed ends of the needles should be cut by means of scissors. It will readily be understood that the manner in which the edges of a wound can be most effectively brought together must be a matter left largely to the discretion of the person who is performing the part of friend to the injured. A little common sense exercised in this way will probably be more effective in guiding his procedure than a large number of rules laid down as applicable to the different cases.

Antiseptic Dressings.—If the wound has thus been closed, it is necessary to do something further in the way of dressing it by way of carrying out the principles of the antiseptic treatment, to which allusion has already been made. If no other material is at hand, the wound should be dressed with clean linen or clean lint. It is necessary to observe this latter point, because a dressing which may be described in any sense as being dirty would necessarily infect the wound. If a medicine chest is at hand, or if the accident occurs practically within reach of civilisation, the best dressing which can be procured is some form of gauze. Such gauze, sold by druggists, may either be impregnated with carbolic acid, with iodoform, with izal, or with other disinfectant. This gauze should be made to cover the wound thoroughly. If any aperture has been left in the wound, on the idea that possibly it may serve as a drainage-exit for matter, the gauze should be placed more thickly at this point than at other parts of the injury, in order that if matter

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actually does form; it may thus be absorbed. Over the gauze absorbent wool may be placed; failing this, use thick layers of lint, the limb or part being afterwards duly bandaged by way of keeping the dressings in position.

The proceeding just described illustrates what is called the *dry-dressing* of a wound. *Wet dressings* are very frequently used in order to further and perhaps more effectively carry out the antiseptic principles already shown. Simple water dressing as a kind of permanent application to the healing of a wound has largely gone out of fashion, seeing that it is extremely liable to promote the growth of microbes. In addition to this disadvantage, it requires to be frequently changed, and such changing of dressings implies naturally danger of the wound being infected from without. Surgeons accordingly to-day are accustomed to use antiseptic lotions. Amongst these a solution of carbolic acid of the strength of from one to twenty to one to forty of water may be used. Occasionally, however, carbolic oil of the strength indicated is employed. Corrosive sublimate or the perchloride of mercury (a poisonous substance) in the strength of one to one thousand of water is also an excellent application, seeing that it is one of the most powerful germ killers known. Boracic acid added to water so as to make an extremely strong or saturated solution, is another application often employed. Friar's Balsam, used slightly diluted or even pure, and applied on strips of lint, forms an admirable dressing for simple wounds, and can be used if no other form of dressing is at hand. Izal, already mentioned, also forms a most admirable form of wet application for wounds. It may be used in the strength of from one to eight hundred to one to six hundred or even four hundred of water.

With regard to *the renewal of dressings*, much will depend of course on the nature and extent of an injury. In the case of an ordinary simple wound, the edges of which have been properly brought together and treated by a dry dressing, and in the absence of any symptoms of pain in the wound (indicating a want of healing power or the formation of matter), the dressing should not certainly be disturbed for some days or possibly for a week. Wet dressings require to be changed more frequently. In changing them, care should be taken that no disturbance of the wound takes place, and also that all risk of infection from the outside as far as possible should be averted. The use of an antiseptic lotion to bathe the surrounding parts previous to the application of the new dressing is advisable.

About Rest.—Finally, an extremely important point in connection with the treatment of wounds insisted upon by all surgeons

is the question of *rest*. As in the case of a broken bone, so with any part which has been wounded, the chances of early recovery are materially increased by keeping the part perfectly still. It can readily also be understood that if any undue muscular action is permitted, such action will tend to force asunder the edges of the wound, and will thus materially delay the process of healing. Yet another caution is of importance, namely, that the bandages used for wounds *should not be too tightly applied*, for the reason that they are apt to obstruct the course of the circulation, and thus to prevent the parts receiving their due supply of healthy blood. If a wound is situated, say, on the leg, the foot might be elevated somewhat, thus favouring the return of blood in the veins.

POISONED WOUNDS

Under the head of *poisoned wounds* fall to be considered special and separate classes of injuries of the kind we are considering. As indicated by this term the characteristic feature of a poisoned wound is the insertion into the system of some deleterious substance which is calculated sooner or later to produce serious effects through its being carried by the blood to the various parts of the body.

Stings.—Certain poisoned wounds are of comparatively minor importance. The *sting of a bee*, of a wasp, or a hornet, represents an ordinary injury of this description, although at the same time it includes in itself all the characteristics of a wound associated with poisoning. The sting may be described as practically consisting of a hollow needle communicating with a poison-bag. Through pressing this bag the poison secreted therein is forced along the hollow of the sting, and thus passes into the wound which the latter has made. There is a striking likeness indeed in respect of this arrangement between the sting of the insect and its mode of operation and the hypodermic syringe of the physician, whereby he is enabled to inject morphia and other drugs into his patient's skin. The *sting of a jelly-fish* in another direction represents a poisoned wound, seeing that in this animal we find stinging-cells which, when they come in contact with the skin, rupture or burst, discharging a dart and a poisonous substance. More serious are cases of *snake bite* and *dog bite*. Here an animal suffering from *rabies* or *canine madness* inflicts an injury developing a liability on the part of the bitten person to acquire the terrible disease called *hydrophobia*.

Taking first in order minor injuries of this description we may

deal first with the stings of jelly-fishes. Injuries of this description most frequent occur in the summer when bathing is practised. The smaller species do not affect the human frame, seeing that their stinging cells are not powerful enough to penetrate the skin. The larger species may, however, sting very severely, and in tropical seas jelly-fishes or their allies are met with which are capable of affecting the human body to a very severe extent. In some cases the affected part swells up and exhibits all the symptoms of a violent inflammation, the effects of which may not disappear for some days. In the case of jelly-fish stings the patient if seriously affected should be made to rest in the recumbent position. Some stimulant may be given to him, especially if he exhibits any signs of collapse. Probably the best application for such stings is that represented by a mixture of ordinary soda and water. This should be used to bathe the parts. In some cases great relief is also experienced by bathing the parts with hazeline and water, whilst the application of oil has also been recommended as a soothing measure.

Bee Stings.—In the case of *the stings of bees* and other insects an important feature may be pointed out in the shape of the fact, that the danger varies with the situation of the injury. A sting on a limb may prove of no great account, but when the injury affects the throat great danger to life may ensue because of the swelling which supervenes. In the same way an injury to the eye should be attended to at once by a medical man, on account of the danger to the organ of sight which might ensue from the progress of inflammation. If the sting be seen to remain in the wound it should be extracted by pressing a watch-key over it. There may be then applied as a lotion ammonia well diluted with water (sal volatile and water will suffice), or if nothing better be at hand a solution in water of ordinary baking soda or washing soda will suffice to lessen the pain. A homely remedy, but one which appears to be effective in the hands of country people, is that of slicing a raw onion in halves, and of rubbing the juice over the part which has been stung. In the case of a sting affecting the mouth or throat hot water should be used by way of gargling the parts, and medical assistance should be at once sought. If collapse or faintness comes on, the patient must be treated by means of stimulants cautiously administered in small doses at short intervals. The ambulance student must also here bear in mind the possibility that in consequence of swelling of the throat the patient may be in danger of suffocation, in which case he must follow the directions already given in the section on *choking*. If it is necessary to open the windpipe to save life the operation described in the section in question should be followed.

Mad Dog Bite.—The nature of *hydrophobia* has already been described in the section (vol. i.) dealing with that particular disease. It will suffice, therefore, in the present instance, to describe briefly the main features which should be followed in the event of an accident of this kind occurring. When a dog has bitten a person it is of the highest importance that the dog should be at once tied up and carefully watched for some days at least. The services of a veterinary surgeon had better be requisitioned in order that the dog should be thoroughly supervised. The reason for this proceeding should be made perfectly clear. If the dog is found to be in a perfectly healthy state, and to show no symptoms of *rabies* or "madness," the bite then resolves itself into a simple injury, namely, a non-poisoned wound. If the dog on the other hand proves to be rabid, by being secured he is prevented from doing further injury, and can then be mercifully put to death. If the dog should be immediately destroyed after inflicting a bite under the idea that it was mad, we naturally lose all evidence as to its exact state. The advice just given should therefore be carefully attended to by way of ascertaining the state of the animal. If the bite has been that of a healthy dog the person's anxieties will on that account be very materially lessened.

The principles on which dog bites may be treated are really those applicable to all cases of poisoned wounds. They are represented first by the duty *of sucking the wound*, so as thoroughly to remove any poison from it. This may be done without danger by any person, the lining membrane of whose mouth is intact, seeing that such poisons can only act when they are directly introduced by a wound into the blood. Sucking the wound therefore may be practised at once, the mouth being afterwards carefully washed out with any disinfectant solution which may be at hand. At the same time *a tight ligature* should be placed between the wound and the rest of the body. In this way, by the use of some elastic bandage (an elastic brace will form an admirable bandage of the kind), the poison is prevented from spreading into the surrounding tissues and body at large. The third duty is that of *cauterising the wound* and destroying the poison at the seat of the wound. The sooner this is done the better. In the event of an injury from the bite of a really rabid dog probably this procedure would be best carried out by heating an iron wire, and by thoroughly cauterising the wound therewith. In connection with the removal of poison from the wound by sucking it, it may be noted as an interesting fact that in all probability the poison of rabies tends to remain at the seat of the wound for a certain period before the poisonous principle (or *toxin*) it develops passes into the system at large. The importance therefore of local treatment can be readily

appreciated. In place of using a red-hot wire *caustics* may be employed, although probably they are not quite so effective as the actual cautery. Burning the wound freely with ordinary caustic or nitrate of silver, or the use of strong pure carbolic acid or nitric acid, are procedures which may be adopted in lieu of the heated wire.

Snake Bites.—In the British Islands we have only one poisonous snake, the viper or adder. The bite of this snake may be followed by death, whilst in any case it is capable of producing very severe consequences. When snake bite happens a ligature should be applied as in the case of dog bite, and the wound may be sucked, the matter extracted from the wound being duly ejected from the mouth, and the mouth afterwards disinfected. The poison should also be destroyed at the seat of the wound in the manner described in connection with dog bite. It is of great importance in this case *to administer plenty of stimulants.* This is by way of counteracting the depressing effect of the snake poison on the heart. The stimulants may be administered in as large quantities as the patient can take them. The probability is that intoxication will not be produced, seeing that the stimulant is practically counteracting the effect of the poison, and that in this sense no special effects appear as the result of the administration of large quantities of alcohol.

Remedies for Snake Bite.—Various remedies have been proposed for snake bite, amongst them being the injection of a solution of permanganate of potash into the blood, whilst ammonia has also been used in the same way. It is doubtful, however, if these remedies have any actual effect on snake-bite poison, and therefore the directions already given for treatment in the shape of sucking the wound, cauterising it, and preventing the spread of the poison through the system, are means which are preferable in respect of the probability of their acting in a favourable manner, and also by reason of their easy application.

Snake Bite Serum.—In connection with snake bite it is interesting to note of late years that the principles of snake poison have been used to inoculate animals. It is found that as the result of this graduated inoculation an animal can bear in time a dose of the poison of an amount sufficient to have killed ten or more of its species. In the blood of such an animal there appears to be developed a substance called an *antitoxin* or *antivenene.* It is this principle which, obtained from the animal's blood, is now used for injection into the blood of human beings who have been bitten, the antitoxin counteracting the effects of the poison. The discovery of this mode of treating snake bite is due to the investigations of

Dr. Calmette of Lille, who, himself bitten by a snake on which he was experimenting, used his antitoxin with success. Professor Sir T. R. Fraser of Edinburgh has also made experiments in the same direction, and a supply of this remedy for snake bite is now regularly used in India and in other foreign countries. In connection with the employment of such a treatment for the prevention of death from snake bite we may refer the reader to the section on hydrophobia (vol. i.) for an account of the Pasteur mode of treating hydrophobia by analogous means.

In connection with snake bite, Sir T. Lauder Brunton, M.D., directs attention [illegible] long ago advocated [illegible] It is recommended [illegible] which at one end [illegible] with the knife, so that the crystals (after being moistened with water or saliva) can be freely rubbed into the wound and surrounding tissues. This appliance could be carried in the pocket in countries where danger from snakes is to be apprehended. Experiments on animals bitten by snakes show that this treatment is of effective nature.

THE TREATMENT OF THE APPARENTLY DROWNED

(See plates illustrating the various modes of performing artificial respiration.)

Considering the extreme frequency of drowning accidents, nothing need be said regarding the importance of this phase of ambulance work. Such casualties are liable to occur at every season of the year. In cases of shipwreck, equally with the overturning of pleasure boats in summer, and in the case of bathers seized with cramp, we find illustrations of the only too frequent occurrence of accidents of the description under notice. If we are permitted to say something regarding *the prevention of such accidents* it might be proper to point out, first, that as regards bathing that practice should not be pursued too soon after a meal. It should not also be undertaken when the body is cooling. There may be no great danger in going into the water when the body is really warm, but in its cooling stage, from the probable presence of fatigue, cramp is apt to be induced. Also, it is of importance that people should not bathe in parts of the coast unknown to them without previously consulting some local authority regarding the probable chances of their safety. With regard to boating accidents the same strong opinion may be expressed. Large numbers of persons in their holiday at the seaside engage boats regarding the management of which they know

absolutely nothing. They may perhaps be safe enough when oars alone are used as means of propulsion. Even then, however, foolish persons in changing their seat in a boat will contrive to capsize it. The exercise of a little care here would prevent many lamentable fatalities. More reprehensible, however, is the practice of people venturing out in sailing boats when they are entirely ignorant of the management of the sails. Such cases of drowning accidents are clearly preventable, and are equally to be included in the list of such incidents as those connected with that extremely foolish practice, often ending in death, the presenting of a gun or pistol at another under the mistaken idea that it is unloaded. Whether loaded or not, no firearm should ever be used in this way. It would be well also if those who have firearms in their premises withdrew the charges when the gun or pistol is not in use.

Minor Cases.—When a rumour is raised that a person has been drowned, or at least has disappeared beneath the surface of the water, we are then brought face to face with a certain definite casualty. There are, however, varying degrees to be noticed in respect of the gravity of the accident. If we begin with a minor accident, we find ourselves face to face with the case of the person who has merely sustained what is popularly known as a "ducking." He has stumbled into the water, and is quickly rescued. He has not lost consciousness, and may be little the worse for his immersion. This little accident presents no great cause for consideration, but all the same, it is a most absurd practice to brave out such an occurrence. The wet clothes should be speedily removed, the body rubbed down with dry warm towels, and if a certain amount of shock has been sustained, warm drinks should be administered. The attention of mothers should specially be directed to the occurrence of this accident in children. When a child has tumbled into a pond or river, and has been speedily rescued, the occurrence of "shock" is much more likely to be attended by certain undesirable results than in the case of the adult, more especially if, in addition to the fright the child has sustained, he has regard to further correction at the hands of the mother for his carelessness in having his clothes wetted. All children therefore who have tumbled into the water should be carefully and gently treated. Warmth should be applied to them, they should be put to bed between the blankets, and the parents should avoid any appearance of anger.

A Graver Case.—Coming now to the second degree of drowning accidents, we find persons rescued from the water who have lost consciousness, either as the result of the accident or as the result of shock, *while in their case breathing has not ceased.* This is a form of acci-

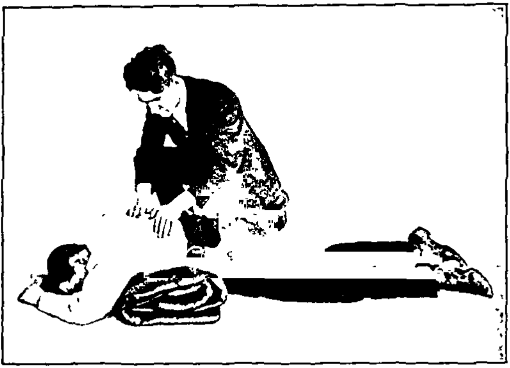

Fig. 13—The Marshall Hall Method (1).

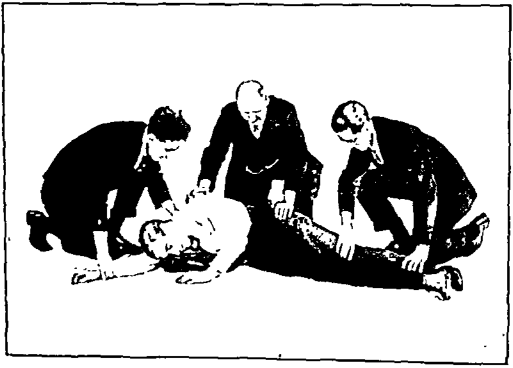

Fig. 14—The Marshall Hall Method (2)

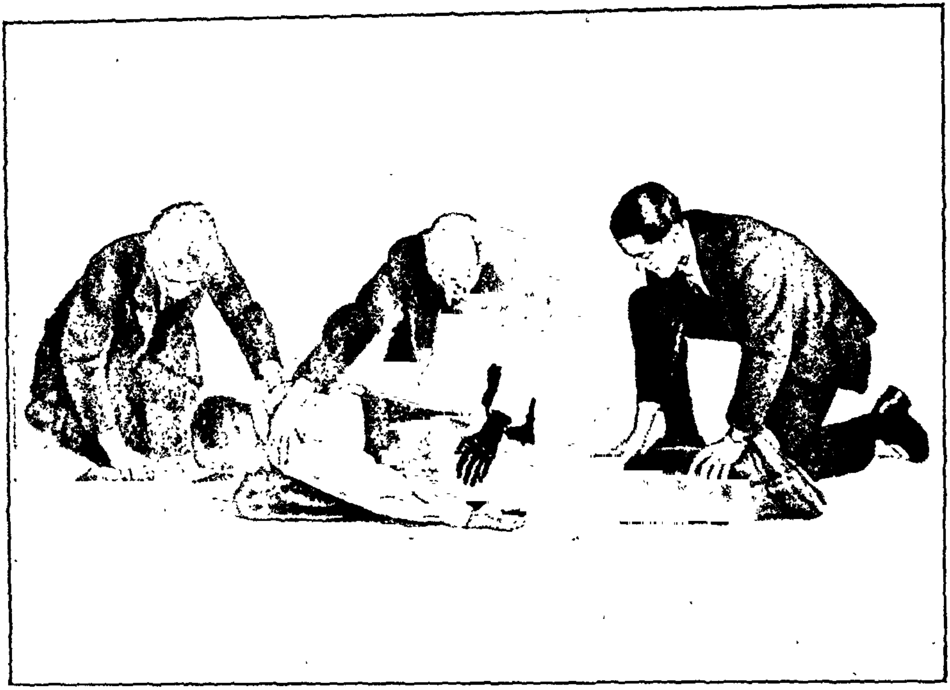

Fig. 15.—The Marshall Hall Method (3).

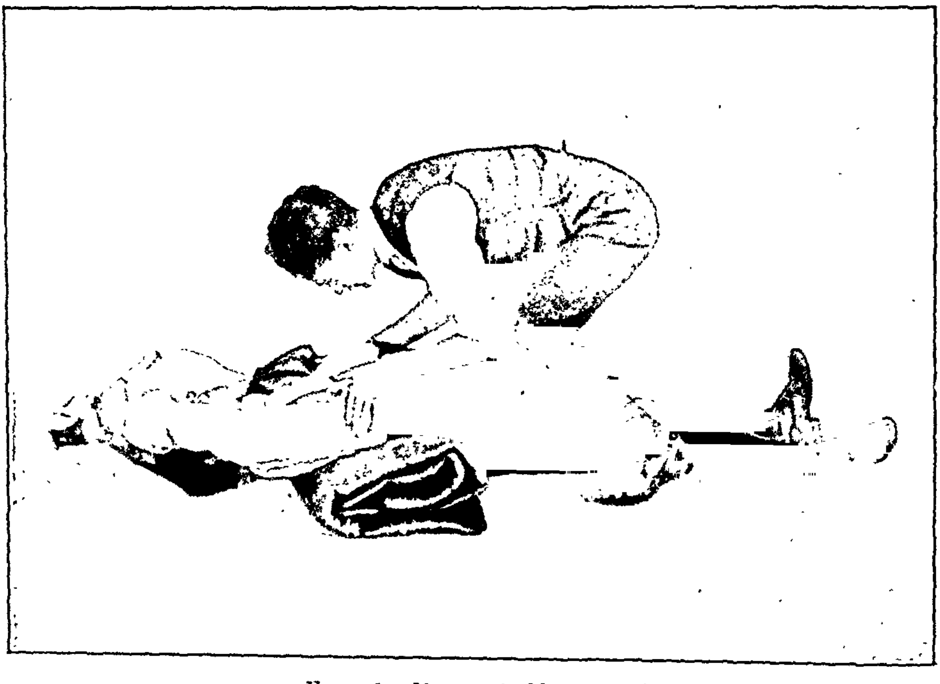

Fig. 16.—Howard's Method (1).

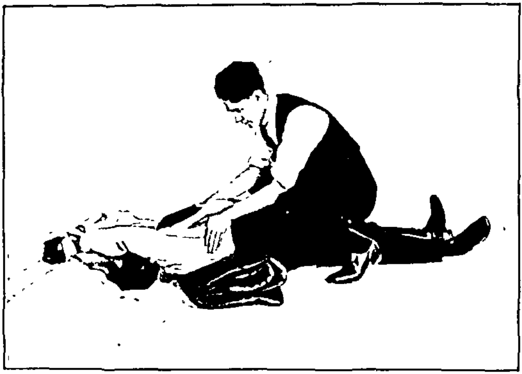

Fig. 17.—Howard's Method (2).

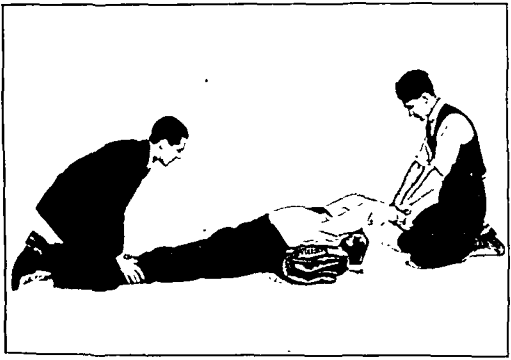

Fig. 18.—Silvester's Method (1).

immersed. There is great excitement prevalent during the process of rescue, and the natural tendency of the human mind under such circumstances is that of exaggerating the period of immersion rather than of lessening it. Hence it is very unlikely that any exact computation of the period during which the person is in the water can be obtained. The golden rule here is practically that which teaches us, that it is our bounden duty in all drowning cases where the period of immersion has been anything within that, say of a quarter of an hour or twenty minutes, to begin at once the work of reviving the unfortunate sufferer.

The Procedure.—The first duty to be done on rescuing the person is to send for the nearest medical man. This is often a point neglected in the anxiety and alarm of the spectators. In the next instance, remove all tight clothing from the neck and chest, and pull the tongue at once well forward in the mouth. It may be added that the act of pulling the tongue forward, as will presently be shown, exercises a highly important effect in connection with the respiration and breathing. Pass the finger into the mouth to see that there is no obstruction to breathing. It might be well to add the remark at this stage of our considerations that in the whole treatment of apparently drowned persons *the tongue must be well kept forward out of the mouth.* If allowed to slip back into the mouth, it will defeat our efforts at restoration. The tongue may be kept out of the mouth by an elastic band or piece of string placed around the tip and under the chin. The body has next to be turned on the face, a rolled coat being placed underneath the chest so as to raise the chest, and to cause the head to be somewhat dependent. Make pressure between the shoulder-blades with the body in this position, so as to aid the removal of any water which may have accumulated at the back part of the mouth. It is needless to say that this action must be performed carefully but quickly, inasmuch as our one object is to commence the practice of artificial respiration at the earliest period possible.

When the body has been treated as described, *artificial breathing* should be at once commenced. There are three familiar modes of performing artificial respiration. These are respectively known as the methods of *Marshall Hall*, *Howard*, and *Silvester*. (See plates.)

Marshall Hall's Method.—The method of Marshall Hall may be thus described:—The patient is laid on his face, a rolled coat or similar object being placed below the chest. The body is then turned on the side, and a little beyond. It is then replaced on the face with an arm under the forehead, so as to keep the mouth in this way clear of the ground. Each of these operations should occupy two seconds.

When the body is turned face downwards, pressure should be made on the back between and below the shoulder-blades, this pressure ceasing when the body is turned on its side. It will be seen from this description that in Marshall Hall's method there are two movements of the body practised. These movements correspond with the act of taking in a breath and that of giving out a breath—in other words, with the acts of inspiration and expiration. When the body is placed on the face, and pressure is made between the shoulder-blades, the chest is compressed, and air is forced out of the lungs, thus representing the act of expiration. When the body is turned on its side, and a little beyond, the chest is free from pressure; the ribs expand in virtue of their elasticity, and air enters the chest. It is needless to note that *these movements must be performed with great regularity to the extent of fifteen times per minute.* If we reckon two seconds during the time the body remains on its face and two seconds for its position on the side, we thus get a rate of the movements at the rate of fifteen each minute. It is needful in this case that whilst one or more persons attend to the movements of the body, another person should see that the arm is replaced below the head as already described, when the patient is placed on his face. Also the side of the body should be occasionally changed—that is for so many times the patient may be turned on his right side, and for so many successive times on his left. The disadvantage of Marshall Hall's method is that it entails assistance, whilst the work of manipulating in this way the body of a heavy individual presents no light task to the operators (Figs. 13–15).

Howard's Method.—*Howard's method* differs materially from that of Marshall Hall, and also from that of Silvester. The patient is instantly turned face downwards, a firm roll in the shape of a coat, pillow, or other object being placed under the stomach and chest. One arm, as in Marshall Hall's method, is placed beneath his forehead by way of keeping the mouth free from the ground. The operator is then to press with his full weight on the patient's back, so that the water is pressed out of the throat. These are, of course, preliminary measures, as in the case of Marshall Hall's system. With regard to the exact procedure in Howard's method, the patient is now turned on his back. A pillow or coat being placed beneath his shoulder-blades, the head is thus made to hang backwards or to depend. The patient's hands are drawn right above his head. The operator now kneels one leg on each side of the patient, so that the patient's hips are between his knees. He fixes his elbows firmly against the hips, and, grasping the lower part of the patient's chest, squeezes the sides of the chest together [illegible]

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time the operator presses gradually forwards, so as to bring all his weight to bear for a space of about three seconds, the position described bringing the operator's mouth just over the mouth of the patient. At the end of the two or three seconds, the operator suddenly jerks himself backwards, and after an interval of three seconds he repeats the previous procedure of compressing the chest. In this way the weight of the operator's body is used as a means of compressing the chest by way of pressing air out, and of imitating the movement of expiration. The sudden recoil of the operator allows the extension of the chest, and in this way permits of air entering it (Figs. 16, 17).

Silvester's Method.—*Silvester's method* is that which finds most favour in the eyes of physicians, and is likewise the process that is best adapted for the practice of the ambulance student. As in the case of Howard's method, one person is capable of carrying out the directions, and this latter point forms a distinct feature and advantage in the absence of adequate help. Silvester's plan may be described as that of working the arms as levers wherewith to produce those movements of the chest necessary for its enlargement and its contraction. After the patient's lungs or stomach have been drained of water as already described, the patient is laid on his back, a coat or pillow being folded under the shoulders, so as to throw the chest well out and to extend the neck, the head being thrown slightly back. The tongue should be kept out of the mouth, although it may be noted that when the chin is lifted the windpipe will tend to be kept open. Kneeling or standing behind the person's head, the operator now takes hold of the arms, and carries them over the head practically as far as they will go. In this way the chest is expanded, and air passes into the lungs. Taking two seconds for this operation, the next movement is at once begun. This consists in bringing the arms *forcibly* down against the sides of the chest, crossing the forearms over the pit of the stomach. The operator leans forcibly upon the arms, so as to press the chest upwards, and in this way by compressing the chest forces air out of the lungs, two seconds being occupied in this latter procedure. It is remarked that when the chest has been thus compressed a distinct sound of air being sent out from the lungs should be heard. It is needful to note that the arms here should be grasped *above the elbows* when raising them beyond the head, for the reason that, if the arms are to be used as levers, we must take care that we move the part of the limb which is attached directly to the chest, namely, the upper arm. If assistance is at hand, a second operator should compress the lower part of the chest from the sides, when the arms are brought down (Figs. 18, 19).

Laborde's Method.—*The method of Laborde*, a French physician, may be mentioned here. It consists in making what are called rhythmic or regular traction movements on the tongue, pulling it out of the mouth as far as it will come, then allowing it to slip back, and repeating this movement fifteen times per minute. The theory on which this procedure is founded is that such traction or pulling forward of the tongue tends to exercise a stimulating effect upon the lungs, and thus to induce the resumption of breathing.

Some Other Directions.—Whilst these operations are being carried on, bystanders may prove themselves of use by the practice of certain subsidiary aids to recovery. Thus, the legs should be rubbed *upwards* with the warm hands or, better still, with warm flannels, to assist the return of the flow in the veins to the right side of the heart. The warmth of the body should be also attended to. Hot applications, if possible, may be applied to the feet. In any case, the drier the body surface and the warmer it can be made the better. Hot and cold water may also be douched *alternately* on the chest, by way of further stimulating the lungs and heart action.

As soon as the patient shows signs of beginning to breathe on his own account, the movements should be continued for some time, but less vigorously than before. They may be stopped when, opening his eyes, he recovers consciousness.

The after treatment of the patient consists in putting him to bed in a quiet room, between the blankets, and applying hot bottles to the pit of the stomach or armpits, and the soles of the feet. He must be placed in a cool, airy room. All excitement and noise must be avoided, and a small quantity of stimulant in the shape of warm brandy and water or coffee may be administered. It is needful here to repeat the caution already given, that in any doubtful case the practice of artificial respiration should be maintained, if necessary for hours, where the slightest hope of reviving the patient exists.

Professor Schafer's Method is contained in a paper read by him before the Royal Society of Edinburgh in 1903. The advantages of this method are summarised as follows:—

(1) The ease with which the physical operations necessary to carry on artificial respiration may be performed; hardly any muscular exertion is required.

(2) The efficiency of the gaseous exchange produced by it between the outside air and the air in the lungs.

(3) The extreme simplicity of the procedure; no complex manipulations are required.

(4) The impossibility of the air-passages being blocked by the falling back of the tongue into the pharynx.

(5) In cases of drowning the readiness with which water and mucus are expelled from the air-passages through the mouth and nostrils.

(6) It involves no risk of injury to the congested liver or to any other organ.

The Method.—Immediately on removal from the water, place the patient face downwards on the ground with a folded coat under the lower part of the chest. Not a moment must be lost in removing clothing. *If respiration has ceased, artificial respiration is to be commenced at once: every instant of delay is serious.*

To effect artificial respiration put yourself athwart or on one side of the patient's body in a kneeling posture and facing his head (see Fig. 20). Place your hands flat over the lower part of the back (on the lowest ribs), one on each side, and gradually throw the weight of your body forward on to them so as to produce firm pressure—which must not be violent—upon the patient's chest. By this means the air (and water, if there is any) is driven out of the patient's lungs. Immediately thereafter raise your body slowly so as to remove the pressure, but leaving your hands in position. Repeat this forward and backward movement (pressure and relaxation of pressure) every four or five seconds. In other words, sway your body slowly forwards and backwards upon your arms twelve to fifteen times a minute, without any marked pause between the movements. This course must be pursued for at least half-an-hour, or until the natural respirations are resumed. If they are resumed and, as sometimes happens, again tend to fail, the process of artificial respiration must be again resorted to as before.

Whilst one person is carrying out artificial respiration in this way, others may, if there be opportunity, busy themselves with applying hot flannels to the body and limbs, and hot bottles to the feet; but no attempt should be made to remove the wet clothing or to give any restoratives by the mouth until natural breathing has recommenced,

Hypodermic injections of atropine sulphate ($\frac{1}{100}$th to $\frac{1}{50}$th grain) and of suprarenal extract (either as adrenalin chloride or in any other form) may be used to assist recovery.

Some Cautions.—Certain subsidiary rules for the treatment of the apparently drowned may be added here. One of the most important points is to *prevent all crowding round the patient.* If he is being treated in a room, it will be better to have open windows, in order to secure that the air which enters his lungs is air of the purest character. No stimulants must be given to him, nor to any person

unconscious from any other cause. *Never place the body of an apparently drowned person in a warm bath.* Such a proceeding might be fatal to him. It is the practice amongst ignorant people in seaside towns to hold the body of the half-drowned person upwards by the heels, under some mistaken notion of draining away fluid from the lungs; just as in other instances the body of a half-drowned man, mouth downwards, will be rolled on a couple of barrels obtained from the nearest public-house. These practices are utterly erroneous, and they are most reprehensible on the account that valuable time which should be spent in the practice of artificial respiration is lost.

POISONS AND POISONING

This subject constitutes one of the most important included in the consideration of ambulance work at large. Its importance is derived from more than one circumstance. In the first place, cases of poisoning may prove to be of a somewhat subtle and difficult nature in respect of the clear diagnosis of the exact nature of the poison which has been taken and of the appropriate remedies and antidotes to be used by way of saving life. In the second place, poisons vary so greatly in nature and effects that it is of extreme importance that a correct knowledge of their properties and of the symptoms they produce should be obtained. In the third place, poisoning accidents are liable to occur practically everywhere—in the home and in the outer world as well.

Cases of Poisoning.—The exact history of poisoning cases divides them into practically *four groups.* The first of these includes *cases of accidental poisoning,* where a substance not known to be poisonous is swallowed. In the second class of cases we find cases which are due to *some error in the administration or giving of poisons,* this class being illustrated by a case in which a person has either taken an overdose of medicine containing a poisonous drug, or has in error swallowed by mistake a mixture intended for external use. The third class of cases includes those of *suicide,* where a substance known to be poisonous is taken with the view of destroying life. In the fourth class we find poison administered *with the deliberate intent to commit murder.* The two classes of poisoning which come under the notice of the ambulance student are those included under the head of accidental poisonings and of suicidal poisonings, but we have here to take into account that the layman may also come face to face with examples of the other two

cases. As already noted in the section dealing with the case of a person found in an unconscious or insensible condition, we see here the importance of the ambulance student duly noting all the circumstances connected with the finding of the body, its position and other details, by way of possibly assisting the law in its efforts to detect crime. By way of general recommendations the appearance and aspect of the person should be closely scrutinised. Possession should be taken of any phials, bottles, or other vessels in the vicinity. Any vomited matters must be carefully preserved. In addition, certain features connected with the patient are also well deserving of notice, such as the condition of the pupil of the eye, the presence of stains on the mouth, lips and tongue, and on the clothes produced by the corrosive or burning effects of certain substances.

It is hardly needful to remark that in all cases of poisoning the one virtue which the ambulance student must exhibit is that of extreme promptitude and quickness in dealing with the case. Cases of poisoning run parallel with those already described under the head of hæmorrhage or bleeding. In the latter promptness of action in arresting the flow of arterial blood is the only means of saving life. The preparation for dealing properly with cases of poisoning includes, therefore, first, a *knowledge of the more common poisons* and their nature; second, the appreciation of the *leading symptoms* which may be expected to follow their administration; third, a knowledge of the *special antidote* to be administered in connection with each poison; and, fourth, *any other subsidiary modes of treatment* appropriate to each individual case. These points will be duly detailed in connection with each class of poisons which falls to be considered in the present instance.

Cautions regarding Poisons.—In connection with disease it has already been shown that *the work of prevention* is quite as important as that of curing the ailments from which we are sufferers. Of poisoning cases the same remark holds good, for there is no doubt that a vast number of calamities and accidents of this kind is due to sheer carelessness on the part of the public. A few hints may therefore be given regarding the care of poisons when these happen to be used in the household. It should be made a first rule that all poisonous substances in a house should be kept under lock and key. When this precaution is observed, children and other irresponsible persons are not likely to gain access to them. In the second place, every bottle containing poison should be clearly and distinctly labelled. The nature of its contents should be set forth on the label, and in a much more ideal state of things than at

present exists, we should find included in the label the appropriate antidote for the poison and the remedies to be used in case of accidents occurring in connection with its use. An illustration of the importance of this latter piece of advice can easily be afforded. Such a substance as salts of lemon, or similar compound, is frequently used in laundries for the purpose of removing stains from linen. These substances are poisonous. They present us each with the appearance of a white crystalline powder. Suppose that a servant obtaining a packet of this material from the chemist uses part of it and is careless regarding the treatment of the remainder, we may find her in the position of leaving in her kitchen or laundry a packet of poison the label of which has dropped off. Here there exists the temptation for its use by ignorant or uninstructed persons when, say, they desire to employ some harmless substance such as carbonate of soda or Epsom salts. The great importance, therefore, of locking up all poisonous substances may be thus demonstrated.

Medicines and Poisons.—An additional caution is that of pouring away or destroying any substance contained in a bottle or packet, the nature of the substance being unknown. Poisoning cases frequently happen through persons swallowing fluids from unlabelled bottles, under the notion that they may represent one harmless substance or another. Yet another piece of advice which is of extreme importance is that, first of attending strictly to the directions given in the case of the administration of any medicine whatsoever. A tendency exists on the part of a considerable section of the public to suppose that because a medicine is tasteless it is therefore innocuous, whilst a higher degree of ignorance is that which results in the doubling of a dose under the notion that because a certain small dose has been prescribed at intervals, doubling the dose will produce the curative effect in a much shorter period of time. Accidents very frequently happen from such an exhibition of culpable ignorance. In connection with the administration of medicines, another point is of extreme importance. It should be made a rule that *no medicine should ever be administered without the label on the bottle being first duly read*, and it is an equally important matter that *no medicine should ever be given in the dark.* Cases have occurred in which a person has been poisoned through rising in the night to take a dose of medicine, and who, thinking that he could lay his hand on the bottle in the dark, has mistaken one phial for another and has suffered accordingly. The close observation of points such as the preceding would avert a very large amount of unnecessary pain and risk of death.

Classification of Poisons.—With reference to the sources

from which poisons are derived, it might be said that they represent practically the three kingdoms of nature. There are thus, first, poisons of animal character. In addition to such substances as are naturally generated as means of defence in certain animals (such as snake poison), we find a liability to the production of often severe symptoms of poisoning through the partaking of foods which have undergone injurious effects of one kind or another. The vegetable kingdom, in the second place, supplies a large number of poisonous plants. Many of the principles of such plants, however, represent substances of great use in medicine. The mineral world, in the third place, contains a large number of substances which are calculated in efficient doses to exercise injurious effects upon the human body. A very large class of minerals, ranging from arsenic and antimony on the one hand to corrosive acids on the other, is employed in medicine and in manufactures.

Another mode of classifying poisons is that which has reference to the particular action each class exerts on the body. The classification of poisons according to this latter method introduces us to, first of all, poisons which are termed *irritants*. This term indicates that such substances act by inducing irritation, or it may be even destruction of the parts of the body with which they come in contact. A burning acid illustrates this class of substances, as also do arsenic, antimony, phosphorus, and the like, whilst included under this head we might place the animal poisons already referred to. The second chief class into which poisons may be divided are those known as *narcotics*. These are characterised by the general tendency they exhibit to produce sleep, deepening into unconsciousness (or *coma*) and death. A third class has often been described which appears to unite in some degree the characteristics of the previous divisions. This third division is known as that of *narcotico-irritant* poisons. Here we find that whilst such substances produce a certain amount of irritation, they also tend to bring about fatal results through producing delirium, convulsions, and other nervous symptoms. Such substances as strychnine, digitalis and poisonous fungi may be cited as representatives of this third class. For practical purposes it may be sufficient to rely upon the simple twofold classification of poisons into *irritants* and *narcotics*.

General Symptoms of Poisoning.—Whilst the special symptoms and features attending the administration of each poison will be duly detailed hereafter, a few remarks may be made on the general symptoms which would suggest to our minds the probability that some injurious substance has been swallowed. In the case of many poisons the symptoms appear suddenly. Some poisonous sub-

stances (*e.g.* prussic acid) act instantaneously, producing death at once if the dose be of sufficient quantity. The interval which elapses, however, between the swallowing of a poison and the production of its effects is as a rule short, and may be distinguished from the onset of ordinary illness by the absence of the usual manifestations and symptoms of disease. It is important likewise to note that in cases of accidental poisoning, or where some injurious substance has been swallowed along with food, the fact of a meal of some kind having been previously taken should be duly noted. In such cases the symptoms may be delayed in their onset. Again, in the case of food-poisoning cases, particularly where an injurious substance has been contained in a meal shared by more than one person, our suspicions that we have to deal with poisoning would be strengthened by the fact that all, or at any rate nearly all, of the persons who had partaken of the refection in question would be similarly affected. Where a poisonous dose of medicine has been accidentally taken, the circumstances of the case would in all probability most clearly point to the cause of the onset of the symptoms, seeing that in all probability the fact that the individual had been taking medicine for one ailment or another would be known to his friends.

The advice may here be appropriately given that when, as should always be the case, a medical man is at once summoned to a case of poisoning, *he should be informed of its nature*, inasmuch as he will then bring with him his antidote-case, containing substances adapted to counteract the effect of the poison, and thus save the time which would otherwise be lost in sending to the chemist for the necessary drugs.

General Treatment.—The treatment of poisoning cases viewed in a general sense includes two chief points. We have, first, to consider the nature of the poison, and, second, the means to be adopted for counteracting its action. Under this latter head there would fall to be considered two important principles—first, that of preventing further injury by removing as much of the poison from the stomach as may have been unabsorbed and thus limiting the chance of a fatal issue; whilst in the second place we have to apply practically our knowledge of the special substance *called an antidote*, which when administered will counteract the effects of the poison upon the system, and thus place the patient in safety.

It is not always an easy task for the ambulance student to discover *the exact nature of the poison which has been taken.* Happily, however, a general rule exists, which if followed will enable him to relieve the patient in so far as ordinary human aid is possible. If the patient has swallowed *some corrosive irritant*

son—one which in popular language would be called a "burning son"—represented by such substances as carbolic acid, nitric acid, triol, or the like, *stains* showing the corrosive action will be found resent in the mouth, or on the lips, tongue, and probably also on the othes. Now in such a case *it would be extremely improper treatment to give an emetic* or substance calculated to produce vomiting, and thus to empty the stomach. The reason here will be sufficiently obvious when we recollect that the effect of such acids when swallowed in any quantity is to burn or destroy all the tissues with whicl they come in contact. Any attempt to make the person vomi might end in causing rupture of the stomach or other parts of the digestive system affected by the acid. The proper treatment here would be *at once to administer oil of some kind* by way of protecting the tissues against further injury. If, on the other hand, a poison such as opium or arsenic has been swallowed, *no such signs of burning or corrosion will be present.* Here it is proper to give an *emetic*, or otherwise to cause vomiting at once by way of removing from the stomach any of the poison which may be unabsorbed. Thereafter the special antidote may be administered. If these rules be borne in mind we are enabled to treat a case of poisoning at first sight even if we are ignorant of the exact nature of the substance which has been swallowed.

Emetics.—In a most extreme case of emergency a patient in whom it is proper to produce vomiting can be made to empty the contents of his stomach by tickling his throat. The forefinger should be passed well down over the root of the tongue, and gently moved over the upper part of the throat by way of bringing about refle action, and so causing the stomach to empty itself. If circum stances are more favourable, and if the patient is within reach of an appliances whatever, large draughts of tepid water, to which musta has been added, in the proportion of a tablespoonful to a tumbler a half of water, will generally cause vomiting. Common salt may a be used in the proportion of two teaspoonfuls to half a pint of te water. If this fails to act the throat may be irritated in addition

Other emetics acting probably more quickly than the foreg are found in the shape, first, of *sulphate of zinc.* This may be g in a dose of from twenty to thirty grains in hot water. If nece the dose may be repeated within a very short space of *Ipecacuanha* in powder, in a dose of twenty grains given in will also act as an emetic. This dose must again be repeate very short interval if the stomach has not been made t Ipecacuanha wine may also be employed, the dose bei ...ful in water. Alum has also been used in the pro

of a tablespoonful to a tumbler filled with tepid water. Its action is, however, like that of salt, not very prompt. Gunpowder has even been used to produce vomiting when no other substance is at hand, the contents of a blank cartridge mixed with tepid water being usually sufficient to produce an emetic effect. *In the case of children* the dose given must of course be proportionately reduced. If tepid water cannot be obtained cold water may be used instead as a medium in which the emetic may be dissolved. If vomiting has occurred without an emetic being required the proper treatment would be to encourage this vomiting by way of removing the poison from the stomach by giving as much tepid water as the patient will swallow. These draughts of water should be given until the contents of the stomach come up perfectly clear.

A Compound Emetic.—In connection with the subject of emetics it is noted that where any difficulty appears to exist in causing vomiting, or where an emetic does not appear to act satisfactorily, the first application should be followed by one of a still more powerful order. What is known as a compound emetic is composed of thirty grains of sulphate of zinc and fifty grains of powdered ipecacuanha. This emetic, it will be seen, combines the properties of two substances, either of which administered singly may of course have the desired effect. Yet another emetic is that known as *sulphate of copper* or *bluestone*. The dose of this substance is from five to six grains. An easy way of administering it would be for the chemist to take twenty grains of sulphate of copper, this being dissolved in a large wineglassful of water. The dose of this mixture would be *one teaspoonful*, and it should be given every three minutes until vomiting has been produced.

The Stomach-Pump.—We have already seen that in the case of the non-corrosive poisons it is proper to empty the stomach at once by way of preventing further absorption of the poison, and by way therefore of protecting the patient against the more serious effects which would attend the passing of a considerable quantity of the injurious substance into the system. In the case of the ambulance student's work we have seen that the production of vomiting is the most simple means whereby this desirable action can be carried out. The doctor himself is accustomed to use a stomach-pump, the advantage of using this apparatus being that not merely can the contents of the stomach be thoroughly and quickly removed thereby, but after the stomach has thus been cleared the stomach-pump can be used to wash out the stomach with tepid water, so as further to clear it from all traces of the injurious substance. Also, in the doctor's hands, *antidotes* or sub-

stances calculated to correct the actions of poisons through their chemical action can be introduced into the stomach by this means. It may be interesting, therefore, to describe a comparatively simple apparatus by means of which the stomach can be emptied and also washed out. A piece of indiarubber tubing of average calibre is taken. This should measure from six to eight feet in length. It is passed down the gullet into the stomach, an operation by no means difficult to effect if the tube be well and carefully carried over the back of the tongue, and made to descend close to the spine itself. The symptoms of choking will cease probably as soon as the end of the tube has passed into the gullet. The free end of the tube is now kept well above the patient's head, and water is poured into it until the stomach is practically filled, and until the water rises in the tube itself. By pinching the tube whilst it contains water, and by lowering the free end of it into a basin placed below the level of the stomach, the tube is converted into a syphon, and the stomach is emptied. This operation can be repeated as often as need be, so that, judging by the character of the water when it returns in a clear fashion, the stomach is known to have been thoroughly washed out.

Antidotes.—An antidote may be described as any substance which through its chemical or other union with a poison converts the latter substance into a harmless one. It may be remarked, in the first place, as an interesting fact, that a large number of substances found within the four walls of a house can be effectively used as antidotes for certain poisons. Just as we have seen that common salt and mustard with tepid water make efficient emetics in the majority of instances, so included in the category of household antidotes we find such substances as oil, flour, milk, white of egg, tea, and coffee, all of these substances having well-defined uses in the treatment of specific cases of poisoning. Even the lime of a house-wall may be used, as we shall hereafter see, as an antidote for the treatment of certain cases of poisoning. A knowledge of the special antidotes to be employed for the correction of poisons forms a very essential and necessary feature in the acquirement of the details connected with poisoning at large. There is no royal road to knowledge of this kind, and the student may therefore be commended to gain such knowledge by paying close attention to the description given of the action of individual poisons, and of the antidotes adapted to correct their injurious effects. It will be noted here that each poison either has its own special antidote, or that one antidote may be common to two or more poisons. The procedure in connection with poisoning cases is that first of all of removing

the poison from the stomach in the manner already described, by vomiting or by aid of the stomach-pump. As has already been shown, this mode tends to remove from the stomach any of the poison which has been absorbed. The administration of an antidote may very well follow upon this procedure as a measure of additional security. It will, however, be noted that, acting on common-sense principles, if any difficulty exists at all in emptying the stomach, the antidote should be administered at once.

A Multiple Antidote.—In his interesting book, entitled "What to Do in Cases of Poisoning," Dr. Murrell gives directions for the preparation of what he terms a multiple antidote. By this name is indicated a combination of substances producing a mixture which might be administered in most cases of poisoning, so that one or more of the substances contained in the antidote would be likely to have the desired effect of counteracting the poisoning action. The formula given by Dr. Murrell for the preparation of a *multiple antidote* is given as follows:—Saturated solution of the sulphate of iron 100 parts, water 800 parts, calcined magnesia 88 parts, and purified animal charcoal 40 parts. These latter to be added to the iron solution must be kept separately, the magnesia and charcoal being kept mixed in a bottle with water. When required, the iron solution is poured into this bottle, and the whole thoroughly shaken. The dose is a wineglassful or more given at a time, this remedy being administered as frequently as the symptoms demand. Such a preparation would probably act as an antidote to poison in cases where arsenic, zinc, or digitalis has been swallowed, whilst it would also tend to neutralise the action, in part, of such poisons as mercury, morphia, and strychnine. It would have little or no action, however, on poisoning by alkalies, whilst it would be useless in cases of poisoning by antimony or prussic acid. Another hint is given that iodide of starch forms an effective general antidote. It is given in large doses for poisoning by alkalies, by sulphuretted hydrogen, and also certain of those subtle poisons known as *alkaloids*. Another formula for a compound antidote is that directing the taking of equal parts of calcined magnesia, powdered wood charcoal, and hydrous peroxide of iron. Of each of these substances, half an ounce is to be given in a tumblerful of water every half-hour. No more than three such doses are to be taken.

Bearing once again in mind clearly the golden rule to be observed in cases of poisoning, that vomiting must never be induced where signs of burning or corrosion are seen on the lips, tongue, and mouth generally, whilst where no such signs are perceived, the stomach should be promptly emptied, we may now proceed to discuss poisons

and their antidotes in alphabetical order. Such a mode of treating this subject will be found useful for easy reference.

Acetic Acid.—Acetic acid may be called the mother fluid of vinegar, ordinary vinegar being practically a weak solution of this substance. A strong form of this acid, known as *glacial acetic acid*, is used as an application to warts. It is highly corrosive. As the only acid likely to prove extremely dangerous would be the latter form of the acid, and as it must necessarily be described as an irritant and corrosive poison, the stomach should not be emptied. The treatment is to give large draughts of soap and water. This proceeding is especially likely to be serviceable if it is followed out soon after the substance has been taken. Otherwise, lime water or chalk and water may be given, or a strong solution of magnesia in water. Other remedies are found in the form of milk, thick gruel, or oil.

Acids.—Under the term *acids*, we popularly indicate a number of substances which have corrosive or burning properties. The most common acids used in manufactories and otherwise are first of all sulphuric acid (popularly known as "vitriol" or "oil of vitriol"), nitric acid (or "aquafortis"), hydrochloric acid, otherwise known as "spirits of salt," oxalic acid, used for the cleaning of brass, whilst also salts of sorrel (binoxalate of potash) is used in laundries, for the purpose of taking out ink and other stains from linen. Carbolic acid also falls to be considered under the head of "acids," and tartaric acid likewise. The main feature of these acids, as has been said, is their action of not merely burning the tissues, but destroying them when taken in sufficient doses. Hence accidents by swallowing acids are usually of a very severe character if the quantity swallowed has been of any great amount. The burning action of such acids is familiarly exemplified in that terrible crime where a person throws vitriol at another, the skin being burned and charred, and severe scars permanently left as the result of the injury. The lips, mouth, and tongue in such a case will be stained. Thus vitriol will cause black staining, hydrochloric acid and carbolic acid give stains of a whitish colour, whilst in the case of nitric acid a yellowish hue is perceived. The patient suffers from intense shock. If vomiting occurs, the matters vomited will be seen to be of dark colour, on account of blood having been brought up with shreds of the injured tissues of the stomach. Very great pain is complained of and also thirst. It is in such cases, of course, that *no attempts should be made to empty the stomach.* Taking the remedies which may be used for such poisoning at large, we find in the first instance that olive oil,

or any similar oil, should be administered at once in fairly large quantity. White of egg, milk, thin gruel, or even cold water, if nothing else is at hand, should be employed. The special antidotes which should be afterwards administered are those known under the name of *alkalies*. Such substances are represented by carbonate of soda and water, by lime and water, and by chalk and water. Plaster from the wall made up into a fluid with water might be used if no other remedy of the kind was at hand. Magnesia is also another useful substance for administration in such cases.

Carbolic Acid Poisoning.—With reference to the special treatment for *carbolic acid* poisoning, seeing that this substance is much in common use as a disinfectant, the proper procedure would be that of giving half an ounce of Epsom salts or half an ounce of sulphate of soda in half a pint of warm water. These substances form the special antidotes to carbolic acid, because, uniting with the carbolic acid, they form substances which are of harmless character. The stomach may be carefully washed out with Epsom salts, whilst it is recommended, when this operation has been finished, the stomach should be left with as much of the solution of Epsom salts as it can contain. White of egg given in water is also a remedy for carbolic acid poisoning. This should be administered in large quantities. Castor oil or olive oil might also be given if other means were unavailable, whilst warmth in this case, and in all cases where shock is present, should be applied to the patient's body. A physician recommends the use of *glycerine* as an antidote to carbolic acid poison. The stomach is washed out with this substance, a large quantity being employed.

In the case of hydrochloric acid (also known as *muriatic acid* or *spirits of salt*) poisoning the treatment is that of giving large draughts of soap and water, whilst bicarbonate of soda or common washing-soda diluted with water should be freely administered. White of egg and water may be also employed.

Nitric Acid is popularly known as *aquafortis*. The treatment for this form of poisoning is practically that already described in the case of hydrochloric acid, while of *sulphuric acid* the same remarks hold good. In this case it is important that the treatment should be promptly commenced, so that if nothing more effective is at hand than cold water this last should be given in large draughts. Common washing-soda diluted freely with water, lime water, or bicarbonate of soda in solution, may be used as in the case of the other acids. In cases where sulphuric acid (or vitriol) has been thrown at a person, a crime common in France on the part of jealous women as regards their rivals or unfaithful husbands, the treatment is that of wiping off

all the acid at once from the skin and washing the parts in water with plenty of soap. The efficacy of this application will be much increased if washing-soda be added to the water. If the eyes be injured they should be washed out with a weak soda solution.

Oxalic Acid, or *salts of sorrel*, also known as *acid of sugar* and *bonnet acid*, frequently figures in cases of accidental poisoning, this substance being sometimes taken in mistake for Epsom salts as a purgative. The symptoms are pain in the stomach, whilst the fluid that is vomited is of a dark-coloured character, owing to its containing blood. There may be purging present, whilst the lining of the mouth will show a whitish hue or tint. The remedy here is to administer chalk, lime, or whiting. Lime from the wall or ceiling may be used. These substances should be given freely in water, and the dose repeated. Thereafter castor oil should be given by way of clearing out the bowels. It must be noted clearly that in the treatment of oxalic acid poisoning *no potash or soda must be given*, inasmuch as the administration of these substances tends practically to increase the danger to the patient.

Tartaric Acid, which is very frequently considered to be a harmless substance, has occasionally caused poisoning. One ounce is stated as a quantity that has produced a fatal dose. The symptoms are great pain in the stomach with convulsions and collapse. The antidote for tartaric acid is to give some form of lime in the shape of chalk, or lime itself, in water, whilst castor oil should be given by way of clearing the bowels. As in the case of oxalic acid, no potash or soda should be administered.

Aconite.—This substance is derived from the well-known plant known as *monkshood* or *blue rocket*, a fairly common plant in gardens. Accidental cases of poisoning may occur through parts of this plant being eaten. Aconite is much used in medicine by way of reducing the temperature and pulse in fevers. An overdose of the tincture of aconite may therefore be taken by mistake. The symptoms produced are dimness of sight, deafness, numbness of the fingers, a tingling feeling all over the body, with a reduction of the pulse and the breathing. The skin bursts forth into a profuse cold perspiration. The treatment is to give an emetic at once or to use the stomach-pump. Stimulants should be freely given in the form of brandy. Warmth is to be applied to the body generally by means of hot bottles, and a mustard poultice may be placed over the region of the heart. The patient must be kept in a lying-down position, and forbidden to raise himself. If collapse occurs, then artificial respiration must be performed. From twenty to thirty drops of tincture of

digitalis may be administered as an antidote in water, after the stomach has been emptied.

Alcohol.—In the case of an overdose of alcohol being taken—a circumstance, unfortunately, only too common—we find the patient with a flushed face, as a rule, livid lips, the skin pale and covered with cold sweat. The pupils of the eyes are expanded and fixed. The patient is extremely giddy, his brain is disordered, and in severe cases he passes into a state of insensibility which may deepen into death. It is noted that a fatal result in the case of alcoholic poisoning, curiously enough, may occur some days after the patient has apparently perfectly recovered. In the case of an overdose of alcohol, it would be proper to use the stomach-pump at once, or, by the action of an emetic, to empty the stomach as thoroughly as possible. Alcohol being of the order of poisons termed narcotics, which tend to produce insensibility in the patient, he must be kept awake by every means in our power. He must be made to walk about. Other means of keeping him aroused are found in flapping him with wet towels, punching him, or by the application of an uninterrupted current of electricity to the legs. The special antidote here is strong, hot, black coffee; and if this cannot be administered at the mouth it would be proper to administer it by the bowel by means of an injection. Cold water should be dashed on his head from a jug which is held above the patient, whilst the alternate douching of head and neck with cold and hot water is necessary. In cases of absolute collapse artificial respiration should be carried out.

Alkalies.—The substances known as alkalies are chemically opposed to those termed "acids." The chief alkalies we have to consider as likely agents in cases of poisoning are ammonia, caustic soda, and caustic potash. It will be understood that these substances produce very much the same results as acids, although the amount of irritation and burning action as a rule is not so severe as is the case with the latter substances. With regard to the general treatment for poisoning with alkalies, acids must be used by way of counteracting their action. In all cases of poisoning by alkalies, oil should be at once administered, or in its place milk, or white of egg. Then the special antidote should be given, namely, acetic acid in the form of vinegar, diluted with water, whilst citric acid, lemon juice, or tartaric acid may also be used. Oil should be afterwards administered.

Almonds, Oil of.—This substance enters into the composition of certain essences used in cooking. The oil itself contains a very considerable portion of prussic or hydrocyanic acid, and death has been known to occur where from fifteen to twenty drops of the oil have been swallowed. Almond flavouring itself has caused death. The

all the acid at once from the skin and washing the parts in water with plenty of soap. The efficacy of this application will be much increased if washing-soda be added to the water. If the eyes be injured they should be washed out with a weak soda solution.

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Tartaric Acid, which is very frequently considered to be a harmless substance, has occasionally caused poisoning. One ounce is stated as a quantity that has produced a fatal dose. The symptoms are great pain in the stomach with convulsions and collapse. The antidote for tartaric acid is to give some form of lime in the shape of chalk, or lime itself, in water, whilst castor oil should be given by way of clearing the bowels. As in the case of oxalic acid, no potash or soda should be administered.

Aconite.—This substance is derived from the well-known plant known as *monkshood* or *blue rocket*, a fairly common plant in gardens. Accidental cases of poisoning may occur through parts of this plant being eaten. Aconite is much used in medicine by way of reducing the temperature and pulse in fevers. An overdose of the tincture of aconite may therefore be taken by mistake. The symptoms produced are dimness of sight, deafness, numbness of the fingers, a tingling feeling all over the body, with a reduction of the pulse and the breathing. The skin bursts forth into a profuse cold perspiration. The treatment is to give an emetic at once or to use the stomach-pump. Stimulants should be freely given in the form of brandy. Warmth is to be applied to the body generally by means of hot bottles, and a mustard poultice may be placed over the region of the heart. The patient must be kept in a lying-down position, and forbidden to raise himself. If collapse occurs, then artificial respiration must be performed. From twenty to thirty drops of tincture of

digitalis may be administered as an antidote in water, after the stomach has been emptied.

Alcohol.—In the case of an overdose of alcohol being taken—a circumstance, unfortunately, only too common—we find the patient with a flushed face, as a rule, livid lips, the skin pale and covered with cold sweat. The pupils of the eyes are expanded and fixed. The patient is extremely giddy, his brain is disordered, and in severe cases he passes into a state of insensibility which may deepen into death. It is noted that a fatal result in the case of alcoholic poisoning, curiously enough, may occur some days after the patient has apparently perfectly recovered. In the case of an overdose of alcohol, it would be proper to use the stomach-pump at once, or, by the action of an emetic, to empty the stomach as thoroughly as possible. Alcohol being of the order of poisons termed narcotics, which tend to produce insensibility in the patient, he must be kept awake by every means in our power. He must be made to walk about. Other means of keeping him aroused are found in flapping him with wet towels, punching him, or by the application of an uninterrupted current of electricity to the legs. The special antidote here is strong, hot, black coffee; and if this cannot be administered at the mouth it would be proper to administer it by the bowel by means of an injection. Cold water should be dashed on his head from a jug which is held above the patient, whilst the alternate douching of head and neck with cold and hot water is necessary. In cases of absolute collapse artificial respiration should be carried out.

Alkalies.—The substances known as alkalies are chemically opposed to those termed "acids." The chief alkalies we have to consider as likely agents in cases of poisoning are ammonia, caustic soda, and caustic potash. It will be understood that these substances produce very much the same results as acids, although the amount of irritation and burning action as a rule is not so severe as is the case with the latter substances. With regard to the general treatment for poisoning with alkalies, acids must be used by way of counteracting their action. In all cases of poisoning by alkalies, oil should be at once administered, or in its place milk, or white of egg. Then the special antidote should be given, namely, acetic acid in the form of vinegar, diluted with water, whilst citric acid, lemon juice, or tartaric acid may also be used. Oil should be [illegible]

Almonds, O[illegible] the composition of certain essences [illegible] in cooking. The oil itself contains a very considerable portion of prussic or hydrocyanic acid, and death has been known to occur where from fifteen to twenty drops of the oil have been swallowed. Almond flavouring itself has caused death. The

nt for poisoning by this substance is similar to that for *acid*, and the reader is therefore referred to this latter head ails.

mmonia.—Ammonia so frequently used in households for ing purposes may sometimes be swallowed by mistake. Here nd intense pain with burning sensations and burns in the mouth, oat, lips, and tongue. Vomiting will usually take place, and the nited matters may be mixed with blood. The great danger of isoning by ammonia is due to the intense irritation which is pro-uced on the throat parts, causing swelling and risk of suffocation. he remedy here is to give vinegar diluted with water. If this is not at hand, lemon juice or orange juice may be given. The ad-ministration of oil, white of egg, gruel, or milk should be attended to by way of lessening the irritation from the poison. Keeping in view the danger in the case of this poison which arises from the swell-ing of the throat parts, it may be necessary that an operation should be performed by way of averting a fatal issue. An additional caution regarding the household use of ammonia is that of advising care in seeing that its vapour is not inhaled from the bottle in which it is contained.

Antimony.—Under this head falls to be included the treatment of that substance commonly known as *tartar emetic*, occasionally used in medicine. This substance has also been frequently employed in cases of murder. The symptoms of poisoning by antimony or tartar emetic are chiefly found in the presence of a metallic taste in the mouth with incessant vomiting. A choking sensation is also com-plained of in the throat, and difficulty of swallowing. The patient also exhibits cramps in the arms and legs, while there is con gestion of the head and face, with an extremely weak pulse an interrupted breathing, leading to collapse and death. It is noted th in poisoning with antimony the symptoms may be distinguished fr arsenical poisoning, in which the symptoms are somewhat similar the fact that the *urine is never suppressed*, as is the case w arsenic has been swallowed. The action of tartar emetic, whi indicated by its name, is that of producing vomiting. This s be encouraged where the symptoms have already appeare whether or not vomiting has taken place, the stomach sho emptied by giving an emetic. The special antidote here is *t* *gallic acid*. Half a drachm is given in water, the dose being as often as may be required. If the vomiting be very pe dose of the antidote should be given after each occasion stomach has been emptied. It would also be prop *k tea* or *black coffee* in large quantities, whil

egg or milk might be given at a later stage by way of soothing the stomach. After the effect of the antidotes has been attained, stimulants are necessary in cases where collapse is imminent, whilst to counteract shock, as in all other cases of like kind, warmth should be applied to the body by means of hot bottles to the feet, and other means.

Aquafortis.—Another name for *nitric acid*. See ACIDS.

Arsenic.—The form of arsenic to which cases of poisoning, accidental or felonious, are due is usually that known as *white arsenic*, the medical name of which is *arsenious acid*. This poison has attained an unenviable notoriety both in cases of accident and of murder. It is contained in certain medicines of which Fowler's Solution is one of the best known, this being a valuable tonic properly used. Arsenic also occurs in rat poisons, whilst it can also be extracted from fly-papers, and the arsenic obtained in this latter fashion has on more than one occasion been used for felonious purposes. Arsenic is largely used by bird-stuffers for purposes of preservation of furs, whilst it is sometimes employed in stables, being mixed with the food of horses, under the idea that it tends to improve their coats and to impart to them a glossy appearance. Arsenic has long had a repute as a substance calculated, if taken internally, to produce a fairness and clearness of skin on human beings. This is entirely a mistake, for it possesses no such power. Therefore all lotions which are alleged to contain arsenic, and which are supposed to be capable of beautifying the complexion, may be rejected as worse than useless.

In arsenical poisoning the symptoms are usually developed quickly. There is severe pain in the stomach with vomiting, the matters brought up being generally of dark colour and streaked with blood, owing to the irritation of the lining membrane of the stomach. Purging is also a symptom of such cases. A sense of choking and tightness in the throat is present. The pulse is extremely feeble, and the breathing painful. The skin is cold and clammy. Suppression of urine, indicating that the functions of the kidneys have been arrested, is usually a prominent sign.

A fatal dose of arsenic varies from two to three grains. The action of the poison it appears, however, is liable to be much modified according to the manner in which it is taken. If taken along with a full meal, the appearance of the symptoms will be somewhat delayed.

The treatment of arsenical poisoning is first of all to administer an emetic, or to use the stomach-pump so as to remove all the poison which may be unabsorbed. It is recommended that large amounts of

hot greasy water, or soap and hot water, or water with which fat has been mingled, should be used to wash out the stomach. Salt and water will also form a useful mixture for this latter purpose. The antidote for arsenic is iron, and this is most easily given in the shape of what is known as *dialysed iron*, which should be administered as frequently as required in doses of one ounce given in hot water. If dialysed iron cannot be obtained, any other form of iron may be tried. Failing the presence of iron, it would be proper to give magnesia in large quantities dissolved in water. Another remedy is castor oil, or olive oil, plain, or equal parts of linseed oil and lime water. This mixture it will be remembered is known as *carron* oil, and is largely employed in the treatment of burns. White of egg mixed with water, or barley-water, is also a useful application. If the patient is in a state of collapse after these remedies have been applied, stimulants should be administered and warmth applied.

Chronic Arsenical Poisoning.—It should be noted here that other cases of arsenical poisoning are also liable to occur, these, however, not being of an acute or rapid type, but due to the long-continued absorption of small quantities of this poison. Thus rooms with wall-papers containing arsenic are liable to have the atmosphere impregnated with compounds of arsenic of an extremely subtle character. It is a mistake to suppose that only green papers contain this poison. In many other circumstances of life arsenic is met with. Even wrappers for sweets, ornaments, and children's toys may contain this substance, whilst artificial flower makers are liable to suffer from symptoms of poisoning due to the fact that they inhale the arsenic which is contained in the flower dyes. The symptoms of *this chronic variety of arsenical poisoning* are sore throat, thirst, dryness of the mouth, with swelling of the eyelids and smarting and redness of the eyes. Loss of appetite is likewise a common occurrence, with pain in the stomach. The skin also becomes dry, and may exhibit certain forms of irritation. The general health is very much affected, sleeplessness being a common symptom, and diarrhœa. The patient loses flesh and exhibits a general breakdown where the poisoning has been long continued. In the absence of any special cause for the symptoms, the presence of arsenic may be suspected in the surroundings of the patient, and wall-papers should be analysed to detect the presence of this substance. The patient recovers when he or she is removed to healthy surroundings and is duly treated with tonics.

Atropine.—*See* BELLADONNA.

Baryta or Barium.—The chloride of this substance has sometimes caused poisoning through being mistaken for common or Epsom

salts. It may form a constituent of rat poison, and is of an extremely powerful nature. The chief symptoms noted are pain in the stomach with purging and vomiting, a feeble pulse, with cramps and convulsions leading to collapse. The nitrate of barium has also been swallowed in mistake for sulphur. The treatment is to empty the stomach at once, the antidote being *sulphate of soda*, given in tablespoonful doses dissolved in water or milk. Epsom salts or sulphate of magnesia may also be given in the same dose, whilst alum in teaspoonful doses dissolved in water might also be employed.

Belladonna.—Belladonna is a substance obtained from the common plant known as the "Deadly Nightshade." The flowers are of a dark purple hue, and the fruit is represented by black berries somewhat larger than cherries, possessing a deep central groove or furrow. Poisoning accidents often occur through children eating the berries. Belladonna is much used in medicine, and is prescribed in various forms. Accidents occasionally happen through the carelessness of patients in taking such mixtures in mistake for internal medicines. The symptoms of belladonna poisoning consist of extreme dryness of the mouth and throat, whilst the water or saliva of the mouth is suppressed. Difficulty in swallowing exists, and the face is extremely flushed. One of the most important indications of belladonna poisoning is the presence of blurred or indistinct vision, whilst it is most important to note the condition of the pupils of the eye. These are extremely expanded, and are insensible to light. In this connection it may be remarked that foolish women who employ belladonna as an application to the eyes for the purpose of enlarging the pupil very often pay for their rashness by more or less continued paralysis of the muscles of the pupil. The patient becomes paralysed and is unable to walk. There is great irritation of the bladder and desire to pass urine, the power of excreting urine, however, being absent. The skin is extremely dry, and it is curious to note that belladonna, even when used in medicinal doses, is apt to produce a rash in the skin resembling that of scarlet fever.

The treatment of poisoning with this substance is to empty the stomach at once by means of an emetic. The patient is to be kept awake by all means in the power of the bystanders. A pint of strong hot coffee may be injected into the bowel, and stimulants are to be freely given. Mustard should be applied to the calves of the legs. In the case of collapse artificial breathing should be commenced and continued if necessary until the patient tends towards recovery. It may be noted that prompt treatment in the case of belladonna poisoning is usually followed by admirable results. It is of import-

ance to empty the bladder in this case in order to avoid reabsorption of the poison, as the kidneys excrete it rapidly.

Bichromate of Potash.—This substance does not frequently figure in the list of poisons apt to be used by the public. It is a substance, however, largely employed in certain manufactories. It belongs to the class of irritant poisons producing great pain internally with purging, the pupils of the eyes being dilated and cramps present. Those engaged in the manufacture of this substance are apt to suffer from sores on the body, with great irritation or ulceration of the nose and mouth. As this substance tends to produce destruction of the tissues with which it comes in contact, it is no uncommon thing to find the nose specially affected in the case of workmen in bichromate factories. The treatment for this poison is to remove it by means of an emetic; the stomach-pump should not be employed. Magnesia or chalk in milk, white of egg in milk, and barley-water also form antidotes to the action of this poison. The patient must be kept warm so as to guard against collapse.

Blue Stone or Blue Vitriol.—*See* COPPER.

Caffein.—This substance constitutes the active principle of coffee. It also occurs in a certain proportion in tea. In medicine it has been used as a substance for the cure of certain varieties of headaches, chiefly of the nervous kind. If an overdose of this substance be taken, pain is complained of in the throat, with giddiness and sickness and pain in the stomach. The stomach should at once be emptied, whilst stimulants must be given freely, warmth being applied to the feet and body at large. The patient should be kept extremely quiet, in a recumbent position.

Calabar Bean.—This bean is otherwise known as the "Ordeal Bean" of West Africa, and accidents occasionally happen when these beans brought from abroad have been left carelessly about, children eating them. The symptoms are giddiness with loss of power in the legs, twitching or convulsions of the muscles, the pupils of the eyes being contracted. An emetic should at once be given. The remedy here would be fifteen drops of the tincture of belladonna given in water by the mouth or injected into the bowel. This remedy should be persevered with, with short intervals, until the pulse begins to quicken and the pupils of the eyes to dilate. Stimulants should also freely be given, and artificial respiration resorted to in the case of collapse.

Camphor.—This substance, much used for the preservation of clothes and furs from moths, has occasionally been responsible for the production of poisoning. In a case of camphor-poisoning the breath gives off an unmistakable odour of the substance, the other symptoms present being delirium with convulsions and disturbance of vision.

The pulse grows weaker, but it is notable that no pain, purging, or vomiting may be present. It is proper in cases of camphor-poisoning to empty the stomach at once, to give stimulants freely, and to give warmth by means of hot bottles and blankets. In more severe cases hot and cold water may be alternately dashed on the chest.

Cantharides or Spanish Fly.—This substance consists of the powdered wing covers of certain beetles. It is a highly irritant poison, and has frequently been used in the most nefarious way, by administering it to women under the idea of exciting their sexual passions. It may be here noted that no such property is possessed by this substance, which in medicine is used for the purpose of making fly blisters. Great irritation is experienced, especially in the kidneys. There is vomiting of matters from the stomach mixed with blood. If this be examined the shining particles of the powder may be noted. The remedy is that of emptying the stomach at once, and thereafter administering any kind of soothing drink such as barley-water, gruel, linseed tea, or white of egg in water. *Do not give oil in any shape.* If much pain exists poultices should be applied to the stomach.

Carbolic Acid.—*See* ACIDS.

Carbonic Acid Gas.—*See* SUFFOCATION (vol. ii. p. 244).

Caustic.—*See* NITRATE OF SILVER.

Caustic Potash.—*See* ALKALIES.

Caustic Soda.—*See* ALKALIES.

Chloral.—This substance is much used in medicine as a sedative and sleep producer, either alone or combined with such substances as bromide of potash. It is a safe drug if used strictly after the fashion prescribed by medical men. When taken in an overdose the danger to life arises from the paralysing action which chloral exercises on the heart. It therefore belongs to the order of narcotic poisons, and falls as regards treatment under the rules applicable to the last-named substances. The patient here tends to fall into a deep sleep, and to become unconscious. The face is much congested, the pulse becomes slow and weak, whilst the breathing is also restrained, and may be of a noisy or stertorous character as in apoplexy. The pupils are dilated, and the skin surface is cold. The stomach should at once be emptied by means of the stomach-pump or by giving any of the emetics already described. The patient must by every possible means be kept from sleeping. He must be walked about, have the chest flapped with wet towels. Mustard should be applied to the calves of the legs. Strong black coffee should be administered as an antidote, *this being injected into the bowel* if swallowing is impossible. The patient must be kept warm with hot bottles applied to the feet, whilst artificial respiration

should be at once commenced and continued when any sign of collapse appears.

Chlorodyne.—This is an extremely useful medicine if adapted for the cure and relief of many ailments ranging from diarrhœa to bronchitis. The average dose is from fifteen to twenty drops, but in the hands of foolish persons, who imagine that a quicker effect is produced by doubling a dose, chlorodyne may prove dangerous through its poisonous symptoms. The treatment for poisoning by chlorodyne is similar to that just described in the case of chloral.

Chloroform.—In a case in which there appears to be danger or collapse from chloroform which has been inhaled everything should at once be loosened about the neck and chest, and the windows of the room widely opened so as to admit fresh air. The tongue should be pulled well forward in the mouth as in the case of the apparently drowned, and *artificial respiration* should be at once commenced and continued. The head should be allowed to be at a lower level than the rest of the body, and when symptoms of danger begin to be apparent in chloroform administration physicians are accustomed to completely invert the body, holding the body up by the legs and allowing the head to touch the ground. When chloroform has been swallowed it is proper of course to empty the stomach. The antidote to be given here is carbonate of soda dissolved in water. Large quantities of this should be given, the patient, as in the case of other narcotic poisons, to be kept awake, whilst strong hot coffee may be given by the mouth or injected into the bowel.

Cocaine.—This substance is much employed for producing what is called local insensibility to pain. Thus it is often injected by the dentist in order to render the extraction of a tooth more or less painless, whilst it is very often used by eye-surgeons to render the eye non-sensitive where operations require to be performed upon it. If a solution of cocaine be actually swallowed an emetic must be at once given and the patient kept awake. Hot black coffee must be administered.

Colchicum.—This substance is obtained from the plant otherwise known as "Meadow Saffron." It has figured in poisoning cases, and has been often administered for criminal purposes. In certain pills known as "gout pills" colchicum forms a chief ingredient, and an overdose of such pills might be liable therefore to induce poisoning. An emetic must be given at once, the antidote being tannic acid or gallic acid, in half drachm doses dissolved in water. Strong black tea will probably accomplish the same end. This treatment may be fortified by white of egg dissolved in water, or by giving barley-water or gruel. If any collapse appears, stimulants should be administered.

Conium.—*See* Hemlock.

Copper.—Sulphate of copper poisoning has already been treated of. If, however, the pure metal which is liable to be obtained from cooking-vessels and in other ways be the cause of poisoning, the symptoms will be found to consist of a strong disagreeable metallic taste in the mouth, with griping and colic, vomiting and purging. *Verdigris* is otherwise known as the subacetate of copper. The remedy is to administer an emetic by way of emptying the stomach, and to give large quantities of tepid water. Afterwards barley-water or gruel may be given by way of soothing the stomach. If great pain exists, linseed-meal poultices should be applied over the region of the stomach.

Corrosive Sublimate.—This substance, also known as the *perchloride of mercury*, forms one of our most powerful disinfectants. It is liable to be swallowed by mistake if carelessness is exhibited in dealing with a solution of this substance, which should always be coloured blue with washing blue or aniline blue in order that its otherwise colourless appearance may be changed to one which will naturally appeal to the eye, and thus prevent its being swallowed in mistake for a harmless fluid. Here we find a metallic taste in the mouth, the lips tending to show white corrosion. There is diarrhœa of a painful character, and the matters passed from the bowel may be mixed with blood. Vomiting is present, very frequently of a persistent character, whilst great pain exists in the abdomen. Suppression of urine is also present. Occasional cases of poisoning with this substance have occurred when corrosive sublimate has been used for the dressing of wounds. The treatment is that of giving an emetic by way of emptying the stomach. The antidote for corrosive sublimate is white of egg mixed with water, and given in large quantities. This latter fact illustrates our previous remark regarding the frequency with which useful substances in the way of antidotes may be found amongst the ordinary belongings of a household. If white of egg is not to be had, plenty of flour and water, gruel, or barley-water may be given. If much collapse exists stimulants will be required.

Croton Oil.—This is probably the most powerful purgative known. If it is swallowed by mistake for another substance, great pain will be present with intense purging, the matter coming from the bowels being of a very fluid and watery consistence. The stomach should at once be emptied, and white of egg, barley-water, or gruel be given. An antidote is found in the form of camphor. Ten drops of spirit of camphor should be given with sugar, or with milk, every ten minutes until five doses have been taken. For the pain, linseed meal poultices may be applied to the stomach, whilst stimulants will require to be given in case of collapse.

Cyanide of Potash.—This substance is closely related to *Hydrocyanic Acid*, otherwise known as *Prussic Acid*. Both are extremely powerful poisons. Cyanide of potash is liable to cause poisoning accidents from the fact that it is largely used in photography and for other purposes. It is a poison whose action is of extreme quickness. There is foaming at the mouth, severe stomach pain, with convulsions and insensibility. A small quantity of this substance, ranging from three to five grains, may prove fatal. The treatment must be extremely prompt. The remedy is to give sulphate of iron dissolved in water immediately as an antidote. Large quantities of such a mixture should be given. The stomach should then be emptied by means of an emetic or the stomach-pump, and stimulants given after the patient is able to swallow. In order to excite the breathing, ammonia may be inhaled, whilst hot and cold water should be alternately dashed on the chest from a jug held at some height above the patient. Artificial breathing must be resorted to in case of collapse.

Digitalis.—This substance is obtained from the well-known plant known as "Foxglove." Various preparations of digitalis are used in medicine, chiefly as a heart tonic. It has been used by quacks for various purposes, some of them of a very nefarious kind. The symptoms begin with purging and severe pains. The pulse is very slow, the matters vomited from the stomach being of a greenish tint. The pupils of the eyes are dilated, and may be insensible to light. The effect on the heart is seen from the alteration of the pulse, which is slow and of a very irregular kind. Death may come suddenly from the action on the heart. The stomach must at once be emptied. The antidote here is twenty grains of tannic or gallic acid given in hot water. Hot strong black tea or coffee may also be given. It is necessary here to administer stimulants by way of stimulating the heart against the action of the poison. Such stimulants may be thrown into the bowel if the patient is incapable of swallowing. One notable point of this treatment is that the patient must on no account be allowed to rise in bed suddenly, or indeed at all, for some time after treatment. Any sudden alteration of the position from the lying or recumbent position into an erect position may be attended with fatal results on account of the condition of the heart.

Essential Oil of Almonds.—*See* ALMONDS, OIL OF.

Essential Oil of Lemons.—*See* OXALIC ACID.

Food Poisoning.—*See* MUSSEL POISONING.

Fungi Poisoning.—*See* MUSHROOMS.

Hemlock.—This is a poisonous plant growing commonly by the wayside. It is liable to be mistaken for parsley, and has caused poisoning when it has thus been used. It contains an active principle

called *conium.* The poison produces giddiness of gait, due to the effect of the poison on the legs, with want of power in the arms, and indeed a loss of power throughout the muscles of the body. The pupils of the eyes are expanded, whilst the sight is affected. This poison appears specially to act upon the muscles of breathing, this function being very much interfered with. The stomach should be emptied at once, the special antidote being tannic or gallic acid, or strong black tea given in large quantities. A direction in connection with poisoning by this substance is included in the advice that the stomach should be emptied again after the antidote has been given. Warmth must be applied to the feet and body, stimulants given, and in case of collapse artificial respiration must be practised.

Henbane.—In poisoning by this plant use the means described under the head of BELLADONNA.

Hydrochloric Acid.—*See* ACIDS.

Hydrocyanic Acid.—*See* PRUSSIC ACID.

Iodine.—This substance is much employed in the preparation of [illegible] used as an appli- [illegible] casionally happen [illegible] ses vomiting and purging, with pain and heat in the stomach. If the vomited matters be analysed they will be of a yellow colour, while if starch has been contained in the food they may be of a bluish tint, because starch with iodine forms a blue colour. The proper treatment here is to empty the stomach, and then to administer starch and water or gruel in large quantities. White of egg and water may be given if starch is not at hand.

Laburnum.—This is an extremely poisonous tree, inasmuch as mostly all its parts are liable to produce toxic effects, seen in purging, vomiting, and convulsions, with ultimate drowsiness and unconsciousness. Children are sometimes sufferers in this case from eating the pods. The stomach-pump should be used or an emetic given, whilst stimulants must be administered. Hot strong coffee should be given by the mouth or administered by the bowel, and hot and cold water alternately dashed on the face.

Laudanum.—*See* OPIUM.

Lead.—Whilst a very small quantity of lead contained in the water we drink will suffice to produce the symptoms of poisoning by this metal, it may become a source of danger through taking *sugar of lead*, otherwise known as *acetate of lead.* Lead poisoning is also apt to occur in a more or less chronic form through the absorption of lead by the skin in the case of persons who are employed in white lead factories. The symptoms are dryness of the throat, with a metallic

taste in the mouth. What is called "lead colic" refers to another symptom, namely, the presence of a pain of the description noted in the abdomen. The muscles of the belly are described as tending to exhibit a rigid appearance. There may be no diarrhœa. Cramps in the legs, with a want of power in the muscles of the lower limbs and convulsions, make up the list of active symptoms. Where chronic lead poisoning is present, as in the case of lead workers, these symptoms are more or less present, but in the less intensified form the presence of lead poisoning may be indicated by the fact that a blue line is developed along the gums. Also in chronic cases of lead poisoning owing to paralysis of the muscles which raise the hand, we find the condition present known as "wrist drop." In a case of acute poisoning, say, by swallowing a certain quantity of sugar of lead, the stomach must be at once emptied. The antidote for this poison is diluted sulphuric acid in water. Half a drachm constitutes a dose. Epsom salts, or sulphate of magnesia or sulphate of soda, may be given, half an ounce being dissolved in half a pint of tepid water. Thereafter milk, white of egg, or barley-water may be given. Hot poultices to the stomach will relieve the colic pain. The treatment of chronic lead poisoning is, of course, a matter for the medical man.

Matches (poisoning by).—*See* PHOSPHORUS.

Morphia.—*See* OPIUM.

Mushrooms or Fungi (poisonous).—It is an extremely difficult matter for uninstructed persons to distinguish between members of the group of fungi which are eatable and those which are poisonous. Hence mistakes in this direction are frequently followed by serious symptoms, seeing that many fungi develop highly poisonous principles. Only a botanist acquainted with the various fungi can pronounce definitely regarding the edible nature of different species, hence people will be wise to limit their foods in this respect to the ordinary or common mushroom. The symptoms are those of great internal pain, accompanied by vomiting and diarrhœa. Brain symptoms are apt to be induced, and the person may become delirious. The pulse is slow, the breathing interrupted, and the pupils of the eyes expanded. Wherever poisoning of this kind occurs give an emetic at once. The typical antidote is *tincture of belladonna*. Twenty drops of this may be given in water, and the dose repeated in half-an-hour if required. When the symptoms have abated, castor oil should be given in order to dispose of any poison which may remain by means of the bowels. When the heart appears to be weakened, the patient should be kept in a recumbent position and stimulants administered, whilst warmth should be applied to the

body by means of hot bottles to the feet, and for any pain in the stomach hot poultices may be used. A word may be here added, to the effect that *it is always dangerous to warm up any dish containing mushrooms.* The process of reheating appears to have a certain effect in imparting to otherwise harmless fungi poisonous properties.

Mussels (poisoning by).—On various occasions epidemics of poisoning due to eating mussels have been reported, and deaths in certain cases have been recorded as the result of eating the shellfish. The high probability is that mussels taken from fresh and clear sea-water are perfectly healthy food, more especially as they are not eaten in a raw state, but used in the boiled condition. When, however, mussels happen to be taken from any place to which sewage has access, as for example from docks or near piers, or when they have been removed from the sides of ships, they appear to acquire poisonous properties and to be capable thus of giving rise to severe symptoms. The signs of poisoning by means of mussels consist of severe pain in the stomach, with vomiting and purging. There is a dryness of the throat. Cramps are present in the legs, whilst severe itching of the skin has been noted in many cases. As is the case with all animal poisons, such cases generally end fatally from the effect of the toxic principles upon the heart. The stomach in such cases must be emptied at once. Thereafter castor oil should be given in order that the bowels may be cleared. The treatment here is to keep the patient perfectly quiet, and to administer stimulants very freely. These may consist of any form of alcohol ranging from brandy to champagne. At the same time, in consequence of the shock which is sustained and of the enfeebled action of the heart, the patient is to be kept warm by every possible means. If any special antidote be required for poisoning by means of mussels, belladonna may be administered as indicated in the preceding *section.*

The remarks applicable to mussel poisoning *apply also to cases of ordinary food poisoning.* Where any tainted food, or at least food which, without being obviously tainted, has developed poisonous principles called "ptomaines," the rules for treatment *are those just* laid down in the case of mussel poisoning. An emetic should be at once administered, a dose of castor oil given by way of clearing the digestive system. For the more active symptoms which appear, and which will probably consist of severe purging, pain, and collapse, stimulants should be *freely given, whilst* hot poultices should be applied to the stomach, and warmth to the extremities. It need hardly be noted that such cases are very often of a grave character, and a medical man should be summoned at once.

Nicotine.—*See* TOBACCO.

Nightshade.—*See* BELLADONNA.

Nitrate of Silver, otherwise known as *caustic* and *lunar caustic,* is commonly used as an application to warts and corns. It is largely used in photography, and also in medicine for diseases of the eyes, and for the cure of other ailments. In its common form as used as an outward application it is seen in sticks of what are popularly called "caustic." Where this poison is the cause of illness *common salt is the antidote.* This should be given at once in water or milk in fairly large quantities. The stomach should then be emptied by the action of an emetic, and afterwards white of egg in water or barley-water be administered.

Nitre or Saltpetre.—This substance has occasionally been swallowed in mistake for common salts. It produces purging with severe pain in the stomach and vomiting. The remedy is to remove the poison by means of an emetic or the stomach-pump, and to give white of egg and water or oil. If stimulants be needed in consequence of the patient showing symptoms of collapse, brandy and water may be given. It is of importance to keep the patient thoroughly warm here, so as to counteract the effects of shock.

Nitric Acid.—*See* ACIDS.

Nitrous Oxide Gas.—This gas, otherwise known as "laughing gas," as is well known, is employed by dentists in order to produce temporary insensibility during the extraction of teeth. Wherever any dangerous symptoms appear in connection with the use of this gas, the tongue should be well pulled forward and the mouth examined to see that no obstruction to breathing exists. Artificial respiration should be at once commenced, the doors and windows being opened in order to secure the presence of fresh air. Hot and cold water may be alternately dashed on the head and chest. The inhalation of oxygen gas is also recommended by way of restoration.

Nutmeg.—This familiar substance has sometimes been taken as a domestic medicine. It has acquired in some quarters a reputation, totally undeserved, as a means for procuring abortion. An overdose produces delirium with giddiness and a tendency towards unconsciousness. Vomiting takes place, and extreme thirst is also represented. The remedy is to empty the stomach, to administer strong black coffee, and to give stimulants thereafter.

Nux Vomica.—*See* STRYCHNINE.

Opium.—Opium is a substance which in itself contains a considerable number of separate principles. One of the best known of these is morphia itself. Opium, or some of its derivatives, enters into the composition of a considerable number of medicines. *Laudanum*

is the *tincture of opium*, whilst preparations of opium also form prominent ingredients in various mixtures and medicines used for the production of sleep, for the treatment of diarrhœa and like affections. Cases of poisoning by this substance may also be represented by the eating of *poppies* or *poppy heads*, from which plant opium is derived. The symptoms of opium poisoning consist first of a state of excitement or exhilaration. This is common to most narcotic poisons. Thereafter succeeds drowsiness, which, as it deepens, passes into unconsciousness, coma, and finally death. In opium poisoning a characteristic feature is the extreme contraction of the pupil of the eye. This is exactly the opposite of the condition we have seen to be represented in poisoning with belladonna, where the pupil is extremely dilated. Also if a person is found unconscious from alcohol poisoning the pupils of his eyes will be dilated, and not contracted. A caution should be given here to mothers to the effect that children are much more susceptible to the action of opium than adults, hence the importance of guarding against the giving of mixtures of a soothing order to children, seeing that many of these contain opium and are apt when incautiously given or carelessly used to produce serious effects.

In any case of opium poisoning, as in the case of narcotic poisoning at large, the stomach should be emptied. The patient should be kept awake by all means in our power. Strong hot coffee or strong black tea should be administered, by the bowel if incapable of being administered by the mouth. Cold water should be poured by way of a douche upon the head, this practice being repeated at intervals. As belladonna has an action antagonistic to opium, thirty drops of the tincture of belladonna may be given in water by the mouth, this dose being repeated in a severe case in from a quarter to half-an-hour if necessary. We have to rely upon artificial respiration where collapse is imminent. It is not proper to give stimulants in a case of opium poisoning.

Oxalic Acid.—*See* Acids.

Paraffin Oil.—This oil has been occasionally swallowed by mistake. It produces pain in the throat and affects the heart and breathing. The skin is extremely cold and clammy, with the pulse feeble. Great thirst is often present, and if the quantity swallowed has been sufficient, insensibility may ensue. The odour of the breath should give an indication as to the poison which has been swallowed. The treatment here is at once to empty the stomach and to keep the patient warm. Stimulants may be freely given to counteract the effect of the poison on the heart.

Phosphorus.—This is a somewhat important poison, from the

act that it forms an essential constituent of the ordinary lucifer natch. It is also found entering into the composition of rat poisons. When phosphorus has been swallowed, vomiting is present with severe pain in the stomach. Where this poison is taken it will be well to examine the vomited matters in the dark, when they will be seen to glow with phosphorescent light. The breath may also present an odour of phosphorus. In certain cases of phosphorus poisoning delirum is present, whilst the specific effect upon the kidneys is seen in the urine being restricted in amount, and by the development of albumen in it. The first rule to be attended to is that *on no account should any oil or fatty substance be administered* in the course of the treatment. The stomach should be emptied by giving an emetic of one kind or another. Half a drachm of the *French oil of turpentine* is the remedy specially to be given here. It is particularly to be noticed that the French oil alone is available here. The dose is half a teaspoonful in milk every half-hour or so, until four or five doses have been administered. In the absence of this remedy magnesia may be freely given dissolved in water, and later on a purge of Epsom salts should be administered. Sulphate of copper, five grains, given in water every quarter of an hour is regarded as a useful remedy, causing vomiting, and also acting as an antidote.

Prussic Acid.—This acid, otherwise known as *hydrocyanic acid*, is one of *the most powerful poisons known to science*. Taken in a sufficient dose it acts instantaneously, the patient falling as if shot. Hence, wherever any chance of treatment exists, it must be very promptly carried out. Note also that the vapour of this acid, whe present in strong form, may prove poisonous or even fatal. Th patient becomes rapidly insensible, whilst the pupils of the eyes a dilated. The eyes themselves are fixed. The face is of a ghast pale or bluish colour, whilst the jaws are fixed and the mouth foar The breathing is markedly affected, and presents us with "gaspin rather than with the ordinary movements of breathing. In a case this kind probably the best remedy, and that most usually appl is that of pouring cold water on the head and neck. If a pum handy, the best thing would be to place the patient below the p and to pump cold water upon him. Apply a stimulant in the s of smelling salts or strong ammonia to the nose. Internal stimu may be given in the shape of brandy or sal volatile, given in w whilst if the patient is unable to swallow, brandy may be in into the bowel. If swallowing be at all possible, or if the sto pump can be applied, the stomach may be emptied; but it w understood that in the case of a sufficient quantity of pruss having been swallowed to produce serious effects, the attention

ambulance student should be concentrated on the other remedies, seeing that these, if attended to at once and quickly, may end in recovery. Artificial respiration should be maintained in a case of collapse, whilst if swallowing be possible, thirty drops of the tincture of belladonna in water may be given. Note here that artificial respiration should be persevered with for some time in the case of a person apparently dead, as instances of recovery have been known in cases which have to all appearance already ended fatally.

Snake Poison.—See section dealing with Poisoned Wounds.

Soda.—*See* Alkalies.

Strychnine.—This substance is the active principle belonging to the plant known as Nux Vomica. It is much used in medicine, being an extremely valuable nerve tonic. It also forms a constituent part of some rat poisons and vermin-killers. Accidents from poisoning by this substance are not uncommon. Death has resulted from persons eating animals, birds, or rabbits which have been killed through being poisoned with strychnine. The symptoms are those practically of "lock-jaw." The body is thrown into convulsions and in a severe case the body may, as in lock-jaw, be thrown into a regular arch, of which one side is represented by the head and the other the feet. The eyes start out of the head with the pupils dilated, the breathing is very much interfered with, and death may result from actual suffocation occurring during one of the convulsive fits. The treatment here is to empty the stomach if the case is seen at an early stage. Owing to the particular class of symptoms present the introduction of the stomach-pump may be effected with difficulty. If an emetic can be given, the stomach should be emptied. The antidote here is *animal charcoal*, which may be given dissolved in water in large quantities. Tannic acid may also be given. If this substance is not at hand, strong black tea may be administered. Tincture of iodine and water also form an antidote. If this substance be given, an emetic should afterwards be administered by way of clearing the stomach. It is usual in a case of strychnine poisoning to give afterwards half an ounce of bromide of potash in water, adding thirty grains of chloral to this mixture by way of modifying the convulsions. Another mode is to mix two drachms of bromide of potash with ten grains of chloral, or even chloral itself in that dose may be given every twenty minutes in water, according to the severity of the case. The physician, by way of remedying the convulsions, would probably place the patient under the influence of chloroform. In addition to these modes of treatment it should be noted that artificial breathing must be kept in mind as the sheet-anchor of treatment. The attempt made in this way to excite the

action of the heart and lungs is frequently followed even in severe cases by success.

Sugar of Lead.—*See* LEAD.

Sulphate of Copper.—*See* COPPER.

Sulphuric Acid.—*See* ACIDS.

Tartar Emetic.—*See* ANTIMONY.

Tartaric Acid.—*See* ACIDS.

Tobacco.—Tobacco, like alcohol, whilst harmless enough in a proper dose or when properly used, is apt to produce certain definite symptoms when from one circumstance or another it is taken in an overdose, or so applied as to injuriously affect the body. Occasionally persons who chew tobacco may exhibit symptoms of tobacco poisoning, whilst when tobacco has been applied, as is the custom in some parts of the country, to open wounds, symptoms have arisen from absorption of this substance. The symptoms are those of faintness and weakness of the heart's action with vomiting. The throat and the brain powers are also affected, whilst the pulse is of a weak character and the skin cold. If the pupils of the eyes be examined, they will at first be found to be contracted as in opium poisoning, and at a later stage expanded. The treatment is to empty the stomach by means of an emetic, and to administer tannic acid or strong black tea, the acid being administered to the extent of half a drachm dose in water. This may be repeated as frequently as necessary. Stimulants should be given freely and the body kept warm. As in the case of digitalis poisoning, it is important that the patient should be made to rest in the lying posture, and be carefully cautioned against assuming the upright posture until he is well.

Turpentine.—This substance has occasionally been taken in an overdose for the cure of worms. The odour of the breath would form one of the most important points in ascertaining the nature of the poison. The symptoms of turpentine poisoning are those of brain disturbance and giddiness, the pupils of the eyes are contracted, and stertorous or noisy breathing, and occasionally convulsions are seen. In the urine which is passed, a strong odour of violets can be perceived. Empty the stomach at once, and then administer an ounce and a half of magnesia or Epsom salts in water as a purgative. For the irritation of the stomach and digestive system at large, give white of egg and water, or barley-water, or gruel. It would be proper in the case of pain continuing to apply hot poultices to the stomach.

Verdigris.—*See* COPPER.

Zinc.—The only preparation of zinc which may here be noted is that known as *chloride of zinc*. This is used in certain ways, but it

is more commonly found forming the essential feature of that disinfectant known as "Sir William Burnett's Disinfecting Fluid." It is a corrosive poison, and produces those well-known effects upon the mouth and lips peculiar to corrosive poisons. Great pain is experienced in the stomach, whilst the vomited matters contain traces of blood. The pupils of the eyes are dilated. Convulsions are generally present, with paralysis of the muscles. Seeing that this is one of those poisons which are apt to destroy the stomach, it is not permissible to give an emetic. The remedy is carbonate of soda, or carbonate of potash, or washing soda dissolved in water. A large quantity of such a mixture may be given. Milk and eggs may also be freely administered. Other remedies are found in the shape of tannic acid, gallic acid, or strong black tea. To relieve the pain, thirty drops of laudanum may be given in water, and poultices applied to the stomach.

FOREIGN BODIES IN THE EYE, EAR, NOSE, THROAT, AND WINDPIPE

By the title "foreign body" medical men mean to indicate some particle or object of larger size which has lodged in some organ or cavity of the body, with the result that its presence causes a greater or less amount of irritation or it may be even danger to life. A speck of dust in the eye may thus be held to represent "a foreign body," equally with a fish bone in the throat rendering swallowing painful; while a mass of food impacted in the windpipe rendering choking imminent, with naturally a certain risk of a fatal result in the latter case, illustrates the condition in question. It is well, therefore, that the public should be instructed in the proper means to be adopted for the relief of such accidents, inasmuch as a vast deal of pain, to say nothing of the prevention of possible permanent injury, may be prevented.

Foreign Bodies in the Eye.—The eye being an extremely delicate organ of the body is singularly liable to exhibit a large amount of irritation from the presence within it of any body however small. A speck of dust, a small portion of cinder, or a very small fly may give rise to a very large amount of pain, whilst more serious are the cases in which some corrosive or burning substance (of which lime is the most common example) has invaded the organ of sight. Dealing first with simple cases in which a fragment or particle has gained admittance to the eye, we must first of all note that in the vast majority of cases the foreign body lies on the outer surface of the

eyeball and is covered by the upper lid. A distinction must therefore be made between an accident in which such a body is merely lying on the surface of the eye and one which has penetrated the eyeball. The latter case is not unfrequently exhibited by a workman who gets what he calls "fire" in his eye, this being the term applied to a small particle of metal which has flown off a larger mass.

The first rule here is that of avoiding any rubbing or irritation of the eye. It may be frankly admitted that this is a rule in some cases extremely hard to follow and to practise, but it nevertheless should be distinctly observed, inasmuch as the rubbing will not merely increase the irritation, but may have the effect of driving into the substance of the eye a particle which may at first only have been reposing on the surface of the eyeball. Also we should remember that where say a particle of lime has injured the eye the rubbing will tend to break down the one particle into many and thus possibly cause a much more widespread injury to the organ of sight. It will be noticed of course that on the entrance of a foreign body into the eye the secretion of tears is markedly increased. This is Nature's way of attempting to limit the irritation, seeing that the tears tend to wash the eye surface and thus possibly to remove the offending particle. Probably the first direction therefore which should be given when any foreign body has gained admittance to the eye would be to keep the eye perfectly still before assistance can be rendered by placing over the eye a pad and fixing it in position by means of a handkerchief. In simple cases where a mere speck of dust is irritating the eye the flow of tears may remove it, aided by blowing the nostril on the side of the injured eye, at the same time closing the other nostril with the fingers. As the tube by which the excess of tears escapes opens into the nose we can see that this process might have the effect of bringing down into the nose the offending particle.

Another simple mode of removing a foreign body from the eye is that of drawing the upper eyelid well down over the lower, so that the eyelashes of the lower lid act as a kind of brush which sweeps the inner surface of the upper lid, and this may remove any particle which is adhering thereto. The use of a small piece of clean white blotting paper gently passed inside the upper lid, and cautiously swept across from one side of the eye to the other, may be effective in removing small particles. A horse hair has also been used for this purpose, the hair being bent into a loop, passed under the upper lid and swept over the eyeball.

Everting the Lids.—If these measures fail to remove the foreign body, then recourse may be had to a very simple expedient which may be readily enough performed by any one possessing a

steady hand. This procedure is described as that of *everting the upper eyelid*—that is, of turning it back so as to gain a view not merely of its under surface but also of the surface of the eyeball, the patient in such a case being made to look downwards and inwards towards the nose. In order to perform this simple operation, the injured person should be seated in a chair with his face to the light. He must be made to look downwards, and the operator standing behind him as the head is bent slightly backwards grasps the upper eyelid by the eyelashes with the thumb and forefinger. The eyelid has thus to be drawn upwards from the globe of the eye. This being done it may be everted backwards simply on itself, or if preferred it may be turned over a thin penholder or knitting-needle which has been laid lightly on the upper surface of the lid. In this way any particle which has become embedded on the under surface of the eyelid may be seen and removed. In order to remove the particle, use the edge of a fine cambric handkerchief which has been dipped in tepid water. If any irritation of the eye remains a drop of castor oil or olive oil may be placed between the lids.

A very useful rule, indeed, in dealing with foreign bodies in the eye and the ear is that which teaches us, that whilst we might do harm by placing other substances in either organ of sense, we cannot do wrong, when in doubt, by placing a little pure oil therein.

Corrosives in the Eye.—A special advice must be given with reference to the treatment of the accident where lime has gained admittance to the eye. The danger here is represented by the possibility of corrosion or burning of the eye owing to the caustic property of the lime. The directions for treating this accident should be rigidly adhered to. If the patient is seen *at once* after the lime has gained admittance to the eye, the eye should be well washed out with a solution of vinegar in tepid water, say about one part of vinegar to six or seven of water. The upper lid should also be everted so that all particles of lime may be in this way removed. Thereafter place a drop or two of castor oil on the eyeball, and keep the eye closed for a time, placing a pad of clean lint wrung out of cold water over the eye. If the accident is not seen immediately after its occurrence, or if vinegar is not at hand, simply sluice the eye with warm water, and place a drop or two of castor oil or olive oil within the eye, pending further treatment at the hands of the doctor. If any acid, such as sulphuric acid (or vitriol), gets into the eye, it should be thoroughly washed out with a *solution of bicarbonate* of soda of the strength of five grains to the ounce of water. Thereafter the eye should be treated with castor oil, as already indicated. Where acid has injured the lids and the eyeball, they should

be dressed with carron oil and lint. Carron oil, it may be mentioned, is a most useful application in all cases of burning, and is made by mixing equal parts of linseed oil and lime water. If the eye is injured by, say gunpowder, all the loose powder should be removed from it by means of a syringe and tepid water, the water being injected under the upper eyelid at the outer edge of the eye, so that it may effectually wash the whole surface of the eyeball. The front of the eye should also be examined and all particles of powder removed, a little oil being afterwards placed on the eye. Finally, it should be noted that where any foreign body has become fixed in the eyeball, a not uncommon result of "fire" in the eye, the proper treatment is to place a little oil in the eye, as described, with a dry pad over the eyeball, and a bandage so as to prevent all movement of the eye. This course will lessen irritation until the arrival of the surgeon. The value of this rule consists in its tending to impress upon the ambulance student the danger which may occur in respect of the infliction of injury on the tissues of the eye by any clumsy attempts to remove an object which has become fixed therein.—(See also section on EYE DISEASES.)

Foreign Bodies in the Ear.—With respect to foreign bodies in the ear, we naturally here deal with an organ that, in respect of its external parts at least, is less sensitive than the eye. A very important caution, however, should be given here in the shape of warning that no force or roughness must ever be exercised in connection with the attempted removal of any object which has gained admittance to the ear-canal. The presence of a foreign body here is not dangerous to life, and if gentle means for its removal are not successful, the patient can perfectly well wait until the services of a doctor can be obtained. These remarks are made because cases of injury to the *drum* of the ear are not infrequent in the case of children who, having placed an object, such as a cherry-stone, in the ear, are apt to be subjected to rough treatment by way of removing it. Such instruments as hairpins and other things roughly used may cause permanent injury to the hearing, besides setting up a risk of inflammation of the brain where the injury is of severe extent.

To remove a foreign body from the ear, a hair-pin, judiciously used, may be tried. The patient should be placed so that the light shines into his ear, and the blunt end of the pin can then be carefully passed into the ear in the hope of looping the object outwards. A piece of waxed twine or thread, looped, may also be used for the same purpose. If these measures fail, syringing the ear may be tried. Tepid water should be used, and the stream of water should be directed along the roof of the ear passage so that the backwash, as it were, may tend

thus to remove the offending object. In cases where an insect has gained admittance to the ear, it will be proper to pour some pure olive oil into the ear by way of killing the animal, which can then afterwards, as a rule, be easily removed. The main precaution, however, may be repeated, that no roughness of any kind is permissible in dealing with an object in the ear.

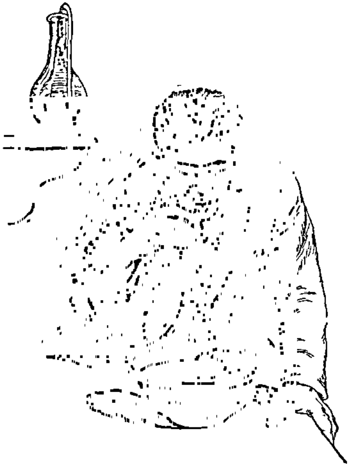


FIG. 21.—Plan of Irrigating the Nostril by Siphon-Apparatus.

Foreign Bodies in the Nose.—Except in the case of children playing tricks upon each other, or it may be in the case of insane persons, the presence of foreign bodies in the nose may be described as a comparatively rare occurrence. Cherry stones may be, however, introduced into the nose of a child by some of its companions. The best method of removing these foreign bodies is to try to dislodge it by pressing on the opposite nostril and then forcibly blowing down the obstructed nostril. If

this fails, a pair of ordinary tweezers, or better still, forceps, passed carefully up the nostril, may succeed in dislodging and securing the foreign body. If, however, any further difficulty may be experienced, and if the foreign body is fixed somewhat high up, a plan which is extremely successful may be carried out as follows: A syphon tube should be used, similar to that employed for the giving of injections. The jug must contain a solution of salt and water, because plain water alone is extremely irritating to the nose. According to the height at which the jug is placed, so the force of the water will be regulated. The tube of the syphon is placed in the opposite nostril to that which is blocked up. If the patient now keeps his mouth open and water be drawn down the pipe or syphoned off (Fig. 21), the current will tend to return by the nostril which is blocked, and thus in all probability force the offending particle out.

Foreign Bodies in the Throat.—By a foreign body in the *throat* is here meant the case of an object which has been so far swallowed and has ultimately come to lodge in the *æsophagus* or gullet—the tube leading to the stomach (Fig. 22, *s*). Where the lodgment has taken place at the back of the mouth or root of the tongue and top of the windpipe, the case, in all probability, becomes one of choking, and will be considered in the section devoted to the treatment of the accident in question. The common case of a fish bone lodging in the throat illustrates the accident under consideration. Even a very small fish bone thus placed may cause a fair amount of pain and irritation in swallowing. An ordinary mode of getting rid of such a foreign body is that of chewing a mouthful of hard crusts of bread, and then swallowing them with a large gulp of water. If this does not succeed, and if the obstruction still remains, it may be advisable to try what vomiting may accomplish. In this case it is necessary, of course, to have some materials in the stomach, say the crusts of bread and water. A draught of salt and tepid water, or from twenty to thirty grains of ipecacuanha powder taken in water, will produce vomiting, when the upward rush of matter from the stomach may suffice to clear the gullet. It has been advised in some cases that when a bone has stuck in the gullet it may be dissolved by the patient swallowing at intervals a weak acid mixture, which any chemist will compound. Failing the removal by these simple means of any obstruction of the gullet, the patient must be taken at once to the doctor who possesses certain ingenious appliances whereby objects lodging in the gullet can be trapped and removed. Where objects have been swallowed and have passed safely enough from the gullet into the stomach, it is necessary to observe certain precautions by way of preventing further and possible injury. In the case of coins,

pins, and the like being swallowed, see, above all things, that no purgative medicine is given. What is required in a case of this kind is not to stimulate the movements of the stomach and bowels, but rather to slow them. Therefore we must give diet so that what is swallowed will tend to become entangled, as it were, in the food in order to be safely passed. In such a case give a solid diet, consisting, say, of porridge, bread and butter, suet dumpling, and the like. Later on in the history of the case the doctor may consider it advisable to give a mild purge of castor oil by way of assisting the removal of the foreign body.

FIG. 22.—Section of Head and Neck Parts.

Foreign Bodies in the Windpipe.—When any foreign body enters the windpipe, so that from its position it tends to obstruct the free current of air passing to and from the lungs, a very grave danger to life is thereby entailed. Unless relief is obtained in a grave case the patient dies of suffocation, and as this event may take place within a very few minutes, it is seen that relief in cases of choking must be afforded with great promptitude if it is to be of any service at all. In order to understand more perfectly the nature of the procedure to be adopted in cases where a mass of food or other object has gained admittance to the windpipe, it is necessary first of all to have regard to the anatomy of the parts involved. In an ordinary section of the head and neck (Fig. 22) we notice the windpipe (*f, i*) lying to the front of the neck, as can be noted by feeling the gristly rings embedded in the windpipe and which serve to keep the tube patent and open consistently with the movements of the neck. At the upper part of the windpipe a prominence known as

"Adam's apple" practically indicates the front of the organ of voice (*i*). In a section of the head and neck we notice the opening of the windpipe or *glottis* (*f*) at the base of the tongue, this opening being guarded by a lid termed the *epiglottis* (*y*), which acts in swallowing by closing or at least overhanging the entrance to the windpipe, thus preventing in the natural act of swallowing the entrance of food to this tube. The food passes beyond and over the epiglottis in the act of swallowing, and thus gains access to the gullet or proper channel for its conveyance to the stomach.

We may now note that any cause which during the performance of the swallowing act tends to keep the epiglottis (*y*) from acting and from fencing the windpipe, or otherwise causes the opening of the windpipe to be left unguarded (*e.g.* speaking or coughing when swallowing) will favour the entrance of food into this tube.

How to treat Choking.—It may be noted that in the vast majority of ordinary cases of choking the mass of food which produces the symptoms does not pass into the windpipe, but lies practically at the root of the tongue (*l*). If it should have gained admittance to the windpipe at all it may be considered that it will lie at the top of the tube. If this be so, it lies *within reach of the forefinger.* What ought to be done in such a case is that the patient should, if possible, be at once laid on the ground, and all articles of clothing instantly removed from his neck and throat. The head may be supported on a low pillow, using some object or other to be placed between the teeth so as to prevent the jaws closing upon the operator's fingers. The fore and middle fingers should then be passed in *at one side of the mouth* and towards the back of the tongue. The fingers should then be swept fully and completely *across the root of the tongue from one side of the mouth to the other*, so that in their passage they will tend to hook forward any object which may be occupying the situation in question. In this way an ordinary case of choking will be relieved through the foreign body being hooked forward into the mouth. It is a matter of the greatest importance to note that part of the direction which insists on the finger being pushed into the mouth at one side. If the finger is thrust straight in in the middle line, the probability is that its tip, coming in contact with the mass of food, would tend to force it further down into the windpipe, and in all probability so to convert a simple accident into a much more serious one. As regards the position of the patient it may be noticed that by some authorities it is recommended that the head of the patient in the lying-down position should be turned to one side or the other. In certain cases the use of such an instrument as a button-hook has been recommended by way of pulling forward the

morsel, but the fingers have the tremendous advantage over all other appliances, in that they are not merely sensitive objects and can make us aware of the presence of a foreign body, but they can practically be at once converted into serviceable hooks, so that the object occupying the position in question can be brought forward into the mouth.

In connection with the accident of choking, it has been sometimes recommended that in the case of young children who may have swallowed some loose body of the nature of a coin or marble, the child should be inverted and held up for a moment or two by its heels. To this plan, or to the familiar slap between the shoulder-blades, no objection can be offered, provided it is done instantly, and provided the object is of a loose character, and such as may be supposed to roll out of the mouth by the ordinary action of gravity. At the same time this practice should not be resorted to in preference to that of using the fingers as already described.

If the foreign body actually gains admittance to the windpipe (*f*) and passes down within that tube, the case becomes naturally of a more serious character, and the aid of a surgeon will undoubtedly be needed in order to extract it. But as a body which gains admittance to the windpipe must be of smaller calibre than the windpipe itself, in such cases it is advisable to try what *a change in the position of the patient* may do in order that he may assume that position of body which will allow air to pass by the side of the foreign body to the lungs. In this way a sufficient amount of air may be provided for his breathing until the arrival of the surgeon. Supposing he cannot breathe when lying on his back he should be placed on one side or the other by way of ascertaining if the foreign body in this way may shift its position.

Opening the Windpipe.—Finally, in cases where the *upper part of the windpipe and organ of voice* are obstructed by some foreign body which it has been found impossible to remove, a simple operation may be performed with the possible effect of saving life. This operation is named that of *laryngotomy*, or in other words that of opening the larynx or organ of voice. Naturally this operation would be of no avail in cases where the foreign body had passed downwards into the windpipe. The patient is laid on his back, a pillow being placed under his shoulders, and the head drawn back over the pillow. The head is held perfectly straight, and the blade of a clean penknife is then passed into a notch running across the windpipe, which can easily be felt when the chin is lifted about an inch or so below the prominence known as "Adam's apple." Thus the knife will naturally pass into the windpipe, and then the opening can be somewhat enlarged. If the patient is *in extremis*,

and death seems imminent from suffocation, the rush of air inwards to the lungs through the opening thus made will in all probability be the means of saving his life. It is important to note that in the performance of this operation very little bleeding takes place, but the blood should be carefully guarded from gaining admittance to the windpipe. A tube of some kind should be placed in the opening, and secured round the neck by means of tapes. Then a flannel or sponge wrung out of hot water should be placed over the throat, whilst the patient must rest in a room, the atmosphere of which is kept moist by means of a bronchitis kettle placed on the fire, and which discharges steam into the room. In some cases, after the removal of the foreign body, the patient may appear in a state of collapse, and breathing also may appear to have stopped. In such a case it will be proper at once to begin and continue the work of artificial respiration, whereby, as in cases of apparent drowning, suffocation from gases and the like, we imitate the movements of breathing. This latter subject will be found fully described under the head of the resuscitation of the apparently drowned.

SUNSTROKE OR HEAT-STROKE

Under the name of *sunstroke or heat-stroke* we have to include what in all probability are two distinct varieties of an affection the result of exposure to heat of an extreme character. There can be little doubt that even a comparatively moderate degree of heat will occasionally produce effects on the human body in consequence of some condition or other preventing the due regulation and control of the body's temperature. This control is largely a matter of nervous action associated with the work of the skin in throwing out perspiration, which, by its evaporation, keeps the body-surface cool, and thus maintains a moderate degree of temperature of the blood. It is not necessary that the person who suffers from heat-stroke should be exposed to the blazing rays of the sun, for we find heat-stroke occurring in the stokeholds of steamships and even in the case of soldiers on the march. In all probability fatigue and a low condition of body represent circumstances which tend to the onset of this ailment. If we divide the cases of so-called sunstroke into those known as simple *heat-stroke*, and, secondly, into those included under the name of *heat fever* or heat-apoplexy, we may within short compass be able to indicate the treatment available for accidents of this kind.

Symptoms.—The symptoms are shown in great weakness, sickness, giddiness, a weak pulse, sweating, and general paleness of the skin's surface. There are also of course signs of fainting, and uncon-

sciousness may come on suddenly, the face being pale, the pupils of the eyes extended or dilated, and with a temperature which is either of a natural degree or which may even be below the latter point. In a severe case, the breathing is affected, as is also the action of the heart. In the more severe case of heat-stroke we find deep unconsciousness, so that the patient cannot be roused at all. The face in this case will be flushed or reddened, the pupils of the eyes are often dilated, but they may, on the other hand, exhibit a contracted condition. The skin may either be hot or dry, or profuse sweating may be present. The breathing is rapid, as also is the pulse. One grave feature of such a seizure is the high temperature, in some cases a height of from 108 to 110 degrees Fahr. having been attained. Such a seizure may run its course in a few hours or may be prolonged for some days. It is liable to terminate fatally by its action on the heart.

Treatment.—When a person suffers from ordinary sunstroke or heat-stroke all clothing should be removed from the neck and the chest. He should be conveyed at once to a cool, airy, and shady place. He must be laid in a flat position, the head low. At once the treatment must be begun by douching him (particularly the head and spine) with cold water. This water should be poured from jugs held at some distance above the patient. If a pump is close at hand cold water may be pumped with some degree of force upon the patient's head, neck, and spine. In some cases ice-bags are applied to the head and spine in order to bring about a reduction of the temperature, which is the great aim of all treatment. Where recovery does not appear to take place quickly, the body should be stripped and enveloped in sheets wrung out of cold water, whilst mustard may be applied to the nape of the neck and also over the heart. If collapse seems imminent, it may be wise to resort to artificial breathing by way of stimulating the action of the lungs. When the patient recovers he must be placed in a darkened room, and kept free from all irritation and disturbance. It may be necessary to repeat the cold applications if any further symptoms should appear. If there is great collapse, a little brandy may be given by way of a stimulant. In the more prolonged cases to which we have alluded very much the same treatment is to be adopted. The rule is that when a reduction of the body temperature of four to five degrees has occurred, the cold treatment may then be suspended. By way of prevention of such accidents strict attention to the general health is necessary. The avoidance of all fatigue and extra exercise and especially extreme moderation in the use of, or total abstinence from, stimulants are also important points in connection with the avoidance of heat-stroke.

FROSTBITE

Frostbite is an injury seldom seen in any but countries where treme cold is represented. It may, however, be found in temperate imates in the course of a severe winter as a result of undue exposure. The parts of the body most frequently attacked are the nose, ears great toes and little fingers. It seems also to have been noted tha the fingers or toes of the right side are more liable to attack tha those of the left. The first indications of frostbite occur in a feeling of redness and heat accompanied by a certain amount of skin-irritation. Later on, the parts so attacked tend to become white and numb, whilst if the effects of the cold be prolonged the parts practically mortify through the cutting off of the blood-supply. A bluish and inflamed condition of the part early in the attack should always be looked upon as a grave symptom and in the light of a warning of danger.

With regard to the treatment of frostbite the golden rule is to be followed that *heat must never be applied to a frostbitten part*. If the patient be placed before a fire, or heat otherwise applied, the chances are his case will be rendered very much worse. This is due to the fact that re-action is brought about so rapidly that the parts with their contracted blood-vessels practically break down and give way. The circulation has therefore to be very gradually restored. Where snow exists, handfuls of it may be used by way of rubbing the frostbitten parts and thus slowly restoring the circulation. Where snow cannot be had cold water may be used. Friction must be kept up in this way until the parts begin to exhibit an increase of heat on their own account. The patient must then be extremely carefully treated. He may be still kept away from the fire and placed betwee blankets, and have small quantities of hot stimulants or of hot sou administered to him by way of favouring his restoration.

INJURIES FROM ELECTRICITY AND LIGHTNING

In these latter days, when the employment of electricity, not me for lighting purposes but as a motive power, has attained such dir sions, accidents of the nature of electric shock have naturally m plied. In the case of a person coming in contact with a live the current should be at once shut off, if possible. If this cann done, he should be pulled away from the wire by means of his ing, whilst, if indiarubber gloves are not at hand, he may be

away by covering the hands with dry cloths. When he has been removed from the wire, place him in a recumbent position, remove the clothing from his neck and chest, and pull the tongue forwards. If the shock is very severe, and he is in a state of collapse, begin at once the process of artificial respiration described under the section dealing with the recovery of the apparently drowned. Cold should be applied to the head, and a mustard plaster may be placed at the back of the neck and the skin over the region of the heart. The patient must be kept warm by being wrapped in blankets. Hot bottles may be placed at the feet, and in the opinion of certain physicians recovery may be aided by injecting into the bowel a solution of hot water in which salt has been dissolved.

Lightning Injuries.—In the case of lightning-stroke, the proper treatment is to place the patient on the ground, doucheing cold water on the face and chest, having removed the clothing from the neck and the latter region. It will be proper to employ the process of friction of the body with warm hands or with warm flannels. Artificial respiration should be at once commenced if the patient is in an unconscious state. Later on a small amount of stimulants may be given at short intervals. It is needful to remark here that in case of apparent death from lightning-stroke, as in the case of apparent death from drowning, artificial respiration should be persevered with for a considerable time.

THE NATURE AND TREATMENT OF FITS

By the term *fit* is popularly understood an affection of one kind or another, the main feature of which is the presence of unconsciousness or insensibility on the part of the person attacked. Various meanings are no doubt attached to the term "fit," regarded from an ordinary or popular point of view. Therefore one of the most important points to be attended to in dealing with this subject is to insist upon the recognition of the fact that the word "fit," as popularly used, has no special significance or value whatever. This arises from the fact that fits of very different kinds fall to be included in the list of such ailments or casualties, and as one fit differs materially in its nature, in its symptoms, and in its treatment from another, it is obvious that no general significance of any value at all can be attached to the term.

Bearing this fact in mind, we may proceed to enumerate the different kinds of fits with which we are liable to meet in the course of our ordinary existence, and to duly detail the symptoms by which

each can be recognised, and the treatment appropriate to each variety applied.

The Fainting Fit or Syncope.—We may begin in order with the kind of fit which is most frequently and commonly represented in our midst. This is the ordinary fainting fit, or, as medical men call it, an attack of *syncope*. This accident is liable to occur practically anywhere. It may occur in the home, in a public assemblage, or under any circumstances of life whatever. The common causes are first of all those of a mental kind, which may be summed up in the word "shock." A severe fright, the reception of bad news, or sometimes the reception of news of a pleasant and unexpected character, will produce the faintness. The physical causes range from a person who takes undue exercise on an overloaded stomach to the breathing of a hot and stuffy atmosphere. A typical instance of a fainting fit being produced probably by a combination of both causes would be found in the case of an individual who, say, listening to an ambulance lecture in a hot room, is mentally perturbed by the description of how to check bleeding. The idea here of treating a wound which might have no effect upon him or her under ordinary circumstances, supplemented by the breathing of a hot, stuffy, and close atmosphere, is readily calculated to bring about the occurrence with which we are dealing.

The *symptoms* of the fainting fit are easily noted. In the first instance it is caused by a temporary weakness of the heart's action, in consequence of which a lessened supply of blood is sent to the brain. This at once produces a feeling of faintness, which may lapse into insensibility. The person falls to the ground, and on noting his appearance we find him with a cold, clammy, and pale skin. His lips and face are pale, and if we raise the eyelid and touch the ball of the eye we find it makes no response to the touch, thus showing that insensibility is complete. If we feel the person's pulse we find the heart-rate to be considerably reduced, and the breathing will in all probability also show a certain amount of slowing down.

With respect to the treatment of the fainting fit we may obtain a valuable hint here as elsewhere from the teaching of nature. When a person faints he falls to the ground. In such a position *his head is kept low*. This is precisely the proper position in which every person who has fainted should be placed. Not merely so, but the legs may be lifted so as to keep the head lower than the rest of the body. The principle thus illustrated is that of assisting the heart in its work of sending a sufficiency of blood to the brain. When this has been accomplished the fainting person recovers his consciousness. On no account should a person who has fainted be set upright in a

chair, for the reason already explained that in such a position the heart, which is temporarily weakened, cannot satisfactorily do its duty or increase its action.

A Golden Rule.—One of the golden rules of ambulance work—there are several of these rules to be borne in mind by the student—in dealing with not merely a case of ordinary fainting, *but with all cases in which a person is found unconscious, is that which teaches us that all clothing should at once be removed from the neck and chest, and that by passing the finger into the mouth we should assure ourselves that no obstruction to breathing exists.* The value of this latter caution becomes apparent when we reflect that in the act of falling, a set of false teeth may readily be displaced from the mouth, and passing to the back of the throat obstruct breathing and cause death by choking, thus converting a simple occurrence into a fatal accident. Having removed the patient's clothing, and placed him in a recumbent position, it is of importance also to note that he must be treated in a pure atmosphere. If the faint has taken place say in a close room, it would be folly to treat him in such a place. Therefore remove him at once to a pure atmosphere, and when the clothing has been removed from the neck and chest, and the head has been kept low, an ordinary fainting case will terminate by the patient recovering consciousness. If, however, this latter result should be delayed, smelling salts should be applied to the nostrils, and in more severe cases, especially where there appears to be some tendency to heart-weakness of a definite type, it might be proper to place a few drops of brandy or other stimulant inside the mouth, although we ought to bear in mind the general rule that an unconscious person should not have anything administered by the mouth at all. Finally it may be noted that by way of preventing fainting we may again gain a hint from nature. When a person feels faint, acting on the idea that more blood should be sent to the brain, the best position to adopt is to stoop, so that his head practically approximates to his heels. By simply bending down in this way, many cases of impending fainting might be avoided.

The Epileptic Fit.—This fit is popularly known as one of "convulsions." It cannot be denied that this description is appropriate enough. If we describe the symptoms exhibited in a typical case of this kind many readers will doubtless be able to recognise the nature of the ailment. A man is passing along the street. He suddenly gives a cry, although this first symptom is not invariably found, and then falls to the ground. He next begins to throw his arms and legs about in the "convulsions" familiar to the public. His body is also bent in various directions, and he may in his struggles injure

himself by coming in contact with objects around. His face is pale; the muscles of his face are likewise thrown into spasms. Frothy saliva issues from his mouth. If the eyeball be touched it will be found to be perfectly non-sensitive, so that no doubt exists that the individual is perfectly unconscious. As the convulsions continue blood may be seen to issue from his mouth. This latter symptom is explained by the fact that he has bitten his tongue. Also, if the hands be noticed, the thumbs will be found in consequence of the muscular spasms to be firmly drawn inwards and bent upon the palms. Altogether the appearance of a person in a fit of convulsions, or as we may more properly term it, an epileptic fit, is a somewhat terrifying spectacle. It is, however, a case in which the instructed bystander may be able to render valuable assistance by way of preventing the patient from injuring himself.

Treatment.—Epilepsy is a disease of the brain. Therefore we recognise at once an epileptic fit as an outward manifestation of a trouble with the cure of which the ambulance student has no concern. In other words, his treatment of the epileptic may be summed up in the advice that he must *keep the patient from injuring himself.* The epileptic patient should be removed to a quiet room. He ought to be placed on a mattress or rug on the floor. He should not be placed on a bed or sofa, for the obvious reason that his movements cannot be restrained there, and that he may in his convulsive efforts throw himself on the ground. Attend first to the golden rule, and remove all clothing from neck and chest. Then restrain the movements. By restraint is not meant that any roughness whatever should be used, for if we attempt to forcibly control the movements of an epileptic whose muscles are struggling against us we should probably end by either breaking his bones or rupturing his muscles. The proper method is to grasp the arms by the wrists and the legs by the ankles, and to restrain the movements even if we cannot stop them. In a longer or shorter period the movements will cease, the patient will open his eyes, and will present a comparatively dazed state. The fit has then passed off, leaving him in an exhausted condition.

An Important Point.—Now comes an important piece of advice. The patient may naturally feel inclined to sleep, and may be therefore put to bed. In any case *he must be carefully watched, because a second fit may supervene on the first, and if left to himself he may in his convulsive movements strangle himself with the bed-clothes, or, as has happened when after his recovery he has attempted to walk home, he may be seized with another fit.* If this occurrence takes place in a dangerous part of the road he may sustain a serious injury. The treatment of epilepsy is necessarily a matter for the physician, but we know that

in the occurrence of an epileptic fit of the kind just described the main line of the treatment is simply that of restraining the movements of the patient and placing him in such a position that recovery may readily take place.

In many ambulance text-books it is advised that some object be placed between the jaws in order to keep the tongue from being bitten. This is a reasonable enough piece of advice, but, if followed, whatever object be used to keep the jaws apart must be carefully watched in order to note that it does not gain admittance to the mouth and thus complicate matters. The importance of seeing that no obstruction to breathing exists in the mouth can be readily estimated, as has been mentioned in the case of the fainting fit. Through the convulsive movements of the jaws, false teeth may readily be detached and choke the patient.

The Apoplectic Fit.—The terms "apoplexy" and "epilepsy" are frequently confused. It must be noted that the terms apply to two distinct ailments. The treatment and the cause of attack or seizure are very different in the one case from that which applies to the other. An apoplectic fit is the result of either the rupture of a blood-vessel in the brain or the blocking of a blood-vessel by a blood clot. In either case the functions of the brain are interfered with to a greater or less extent, much depending in this case upon, first, the size of the clot, and, second, the particular region of the brain in which the clot or blockage is represented. Apoplexy is a common enough ailment in persons above middle age, and when it is mentioned that *paralysis* to a greater or less extent, either affecting one side of the body or both sides, is a result of apoplexy, we can understand the somewhat complicated nature of this ailment in respect of its effects upon the body at large.

When a person is struck down with apoplexy he, as a rule, at once falls senseless to the ground. The symptoms are of a very different nature from those we have witnessed in an epileptic fit. In apoplexy the person lies like a log; *there are no convulsive movements of his body.* The face of the apoplectic man is flushed and congested, and his breathing is of what is called a *stertorous character;* in other words, the sound is that which might be emitted by a kind of snoring taking place in the throat. When we look at the face we may perceive in most cases that one half of the face is altered from the other, the muscles being drawn to one side. On that side the arm and leg will be found, as a rule, helpless and paralysed. In such a case we see here the occurrence of what physicians term *hemiplegia*, or paralysis of one side of the body. It may be added that in the case of this half-paralysis of the body the injury to the

brain will be found on the *opposite* side of that to the side of the body which is affected.

The duration of the unconsciousness, as has been explained, will depend on the extent of the injury to the brain. In a mild case consciousness may be recovered very speedily, whereas in severe cases weeks may pass without the person awakening, and in fatal cases the unconsciousness sooner or later merges into death.

Treatment.—In the treatment of apoplexy the golden rule must again be followed. All clothing must be removed from the neck and chest. The patient must be conveyed gently and skilfully to bed. He must be placed in a darkened room. *The head must be kept high in this case*, which is the opposite of the fainting fit, seeing that we do not desire that more blood than is necessary should go to the brain in the case of an apoplectic man. Another most important rule in the treatment of apoplexy is that *no stimulants must be given.* Bear this rule very clearly in mind, for the plain reason that there are many persons in this world who are prone to give stimulants in all cases of accident. If a person seized with apoplexy has any stimulant administered to him, we readily see that such administration will increase the action of the heart, and will thus, by sending additional blood to the brain, tend to make matters infinitely worse in that important organ. For the rest, the patient must be skilfully nursed, and the doctor sent for. If medical aid be long delayed it might be of importance to place a couple of drops of croton oil on the tongue of the patient by way of procuring action of the bowels. Applications in the form of ice-bags to the head, or clothes steeped in cold water and vinegar, also form adjuncts to the treatment.

Drunk or Dying?—In connection with apoplexy, it is necessary here to mention a very important circumstance which has a very direct bearing on the safety of the public. In newspapers we may frequently read paragraphs bearing the above heading, and detailing how the police, finding a man in what is apparently a dead-drunk state, have taken him to the police-station, placed him in a cell, and, on the supposition that he was suffering from an excess of drink, have left him there for some hours. Later on it has been discovered that the man is dying from a brain-seizure of the nature of apoplexy. Naturally this treatment is much resented by the public, who recognise that "some one has blundered." If the police made it a binding rule that *all cases of insensibility, whether due to drink or to any other cause, should be seen by a doctor at the earliest possible opportunity*, they would not be liable to be charged with culpable neglect.

A typical case of this kind may be readily described. A man is

found lying in the street apparently dead-drunk. The policeman's mode of diagnosis is rough and ready. He detects the smell of alcohol in the man's breath, and naturally concludes that he is a "drunk and incapable" subject. On this supposition the man is treated simply as a drunkard, whose best refuge is a cell in the police-station. *Even if the man were insensible from alcohol alone, and could not be roused, he is as distinctly a case for the hospital or physician as a man who has become unconscious through swallowing a dose of opium, or the man who has been struck with an apoplectic fit.* Deaths from excess of alcohol are not uncommon, and therefore if a man really suffering from such excess died in a police-cell, the matter is obviously one reflecting quite as much on the credit of the police as if the supposed drunk man were allowed to die in the station, when in reality he had been struck down by apoplexy. Furthermore, the police should remember *that apoplexy often occurs in drunken subjects.* The effect of excess of alcohol is witnessed in disease of the blood-vessels of the brain, seeing that it renders them less elastic, and therefore more likely to be ruptured. The case of a person, therefore, who has really not been absolutely drunk, but who on emerging from a public-house is struck with apoplexy, can readily be imagined as one which is liable to be thoroughly misconstrued. If every unconscious man were seen by a medical man as soon as possible after he came into the hands of the police, those most regrettable incidents of persons dying in police-cells without attention would be avoided.

The Uræmic Fit.—Uræmia is a term applied to certain bodily results in the way of disease caused by the accumulation in the blood of certain waste bodily products which in health are excreted or got rid of by means of the kidneys. One result of this accumulation is that the blood acquires poisonous properties, and when these latter reach a certain stage of development, they affect the brain and nervous centres, producing what we term a uræmic fit. It will be understood, therefore, that practically this fit is associated with kidney-disease. The symptoms here may resemble somewhat those of epilepsy. They are preceded for a certain time by headaches, pains in the muscles, and twitchings. When the convulsions occur there is frothing at the mouth, with breathing of the character we notice in apoplexy. The patient falls unconscious, and after the convulsions cease he remains in what is called a comatose or dull and sleepy state. Blindness is noted to follow a fit of this kind, or even sometimes to precede it, but this condition passes off in the event of the patient recovering. It will readily be understood that a person suffering from a fit of this kind may be mistaken for a person [illegible]

plectic fit. Very little can be done by way of relieving a fit of s kind. The safest plan of treatment will be that of conveying e patient to bed, to keep the head moderately high, and to send for e doctor. Treatment of a uræmic fit, amongst other things, includes upping the loins (see vol. i. p. 97) by way of relieving the stress of he kidneys.

The Hysterical Fit.—A hysterical fit may be described as amounting practically to a fit of temper of an uncontrollable kind, usually seen in the case of excitable girls or young women, but also occurring occasionally in the male sex. When a little child throws itself down on the ground in a fit of temper, screams and clutches the carpet, we find an example of what may be called infantile hysteria, seeing that for the time being, as in the case of the adult hysteric, the child is unable to control his feelings. Hysteria, therefore, is no doubt a condition which in the majority of cases depends upon some form or other of ill-health or weakness which should be corrected by appropriate medical advice.

The curious feature of many hysterics is their ability to mimic various diseases. There is a form of hysteria in which certain epileptic symptoms may appear, and it is probable that these latter may exemplify a case of true brain disease. On the other hand, an ordinary hysterical fit, as already described, is one which need cause no alarm. It is not as a rule difficult of recognition. The subject, as has been said, will generally be a girl or woman either in a weak state of health or one of a peculiar nervous temperament. Something occurs in the way of causing pain, rage, or disappointment. Immediately she begins to laugh or to cry, whilst she may exhibit convulsive movements of her body and give vent to loud shrieks. In a typica case she will throw herself to the ground, and convulsive movement may appear. There will, however, be an absence of any viole convulsions as in epilepsy. The face will not necessarily be pale, n will there be frothing at the mouth. If we raise the upper eyelid a touch the ball of the eye, it will be seen to shrink, a clear proof t the patient is not unconscious at all. Indeed, it may be said tha hysterical girl is very acute and alive to everything that is going around her.

The treatment here may be summed up in three words—"ne the patient." Sympathy and attention are simply thrown away her. Her disease, if we may so call it, grows and feeds upon kin and attention. If she begins to think and to feel that people p heed to her, she will all the more speedily recover, and if any f aid may be required in the matter of recovery, a doucheing wit

water will probably be found as efficient a means as any other for ending the fit.

Epidemic Hysteria.—It is curious to notice that just as a fainting fit in one person may produce a like occurrence in another through some form of sympathy, so one hysterical woman may cause a number of others like constituted to pass into fits. *Epidemics of hysteria* have been known to occur in convents, in schools, and like places. There is one important caution regarding hysterical girls which should not be neglected. Whilst an ordinary passing hysterical fit is a matter of no consequence whatever, and simply reveals an ebullition of temper, if a person on the other hand exhibits a tendency to the recurrence of such fits and frequently suffers from them, passing into the hysterical condition on the least provocation and on the slightest notice, such a case should not be treated on the principles just laid down. It is obvious that here the nervous system of the individual is thoroughly upset. Therefore, assuming that a state of ill-health is responsible for the hysteria, the services of the physician should be sought by way of removing the bodily weakness, and in this way of curing the disease.

The Feigned Fit.—A feigned fit represents an impostor's trick, whereby in great cities men who make a livelihood out of the credulity of their neighbours contrive frequently to reap a rich harvest. In London an individual who practises his trick, against which the ambulance student should be on his guard, is known as the "King of the soapy fits." This seizure generally takes place in the neighbourhood of a public-house. The individual falls, he begins to throw his arms and legs about, feigns unconsciousness and foams at the mouth. If the character of the mouth secretion be noticed, it will be observed to be of a much more frothy character than is natural to an epileptic person. This result or symptom is produced by means of a piece of soap which the person has concealed in his mouth. Sympathetic bystanders who rush to his assistance probably open his waistcoat, and there is frequently found attached to the front of his shirt a placard which informs "kind Christian friends" that the individual is subject to these fits, and that brandy is the proper remedy. Uninstructed bystanders immediately proceed to put this recommendation into force. After he has thus obtained what may be called "drinks on the cheap," he rises, still carrying out his mimicry of a dazed condition, asks for alms, which are readily given to him, and departs to resume his labours in a fresh and distant part of the town. It need hardly be said that the remedy for this description of trick is to be found in the shape of a policeman, a

conviction before the magistrate, and free board and lodging at the city's expense for a certain period.

Unconsciousness and its Causes.—Having already dealt with the subject of insensibility as related to *fits*, it may be useful if, by way of addendum to this topic, we devote a few remarks to the consideration of *unconsciousness at large.* This information is necessary, seeing that a person may be found in a state of insensibility from causes other than those represented by fits. It may be regarded as of the highest importance that the ambulance student should as far as possible endeavour to ascertain the particular cause of the insensibility, seeing that the treatment of one case, as has already been noted, differs materially from that appropriate to another. If we sum up the causes of insensibility, we may thus enumerate them:—First, unconsciousness arising from *shock* or *collapse.* This condition, we have already seen, is represented in most cases of injury. Second, we find cases of insensibility arising from *fits* of various kinds. The special symptoms of fits have already been noted, ranging as these accidents do from the simple fainting fit, to apoplectic and epileptic fits. A third series of cases of unconsciousness are those of *injury to the head* in the shape of concussion of the brain or fracture of the skull, with consequent compression of the brain. A fourth series of cases are *those due to the action of certain kinds of poisons,* of which alcohol and opium are the principal representatives; while a fifth class includes results due to *suffocation, drowning,* and other causes leading to the production of insensibility. It is not necessary in this place to enter into detail regarding the special features presented by each of these different accidents. A few points are, however, permissible concerning the general routine which should be observed in determining in what direction our services in the way of first aid may be properly applied.

Leaving fits out of the question, and also omitting the topic of shock, which has already been treated, we may direct attention to *injuries of the head and brain.* If a person is found insensible, and if we suspect he has suffered any injury of the head resulting in insensibility, a close examination of the head should be made. In this way we may be able to detect the occurrence of swelling of the scalp, the result of bruising, while on carefully passing our hands over the surface of the scalp, we may detect the presence of fracture, and find a movable portion of bone where we should expect solidity. The presence of wounds and of blood should be looked for in such an event. If bleeding is found to have occurred from the ears and from the nose, it will probably be found that a fracture of the base (or floor) of the skull has taken place. The presence of this latter symptom is

therefore a valuable one in indicating to us the probable source of the unconsciousness.

In *the case of a person who has swallowed some narcotic poison* (that is one tending to produce insensibility), we should find first of all absence of any external injury sufficient to account for the insensibility. If the case happened to be one of alcoholic poisoning, the smell of the breath would be probably sufficient to indicate the cause of the unconsciousness, but we must again remind the reader that a drunken man might be seized with apoplexy, and his unconsciousness might be due to the latter cause and not to the effects of alcohol. This topic has already been treated under the head of "Drunk or Dying?" In the case of *opium poisoning*, or poisoning by other narcotics, the condition of the pupil of the eye should be carefully looked at. Here we should expect to find no odour of alcohol and no head injury. The particular symptoms of alcoholic poisoning and of opium poisoning will be found duly dealt with under the section devoted to the subject of poisons at large.

How to Treat Unconsciousness.—The *general rules for the treatment of unconsciousness* may be therefore briefly summed up by saying, that where any doubt exists regarding the cause of the unconsciousness medical aid should be sent for at once. In the next instance, the golden rule which applies to all cases of unconsciousness should be followed, namely, removal of all clothing from the neck and chest. The mouth should be examined to see that no obstruction to breathing exists, and the tongue should be pulled forward. The body of the patient should be laid flat, and the head kept moderately high. It might be well to apply cold to the head, whilst as a general rule, warmth to the feet by means of hot bottles should be secured. The patient should be placed in a cool room amidst plenty of fresh air. When in doubt as to the cause of the unconsciousness never give stimulants at all, and remember also another golden rule, that against trying to make an unconscious man swallow. It has already been noted as a matter of importance, that the body should be carefully examined to ascertain the existence of wounds of all kinds, whilst the possibility of the existence of broken bones should not be overlooked. The breathing may also be noted, seeing that, as in the case of apoplexy, the particular character of the respiration gives a very definite clue to the nature of the ailment. If vomiting has taken place, the vomited matters should be carefully preserved by way of providing material for chemical analysis. As the ambulance student may have to come face to face with cases of crime as well as cases of accident, he ought to observe distinctly the position of the body when found

and likewise any other circumstances connected with the state of the patient (such as any particular disorder of dress), whilst he should also take possession of any bottles or other objects which may be found in close proximity to the patient. Valuable clues can be afforded to justice in cases of crime through the bystander carefully noting the circumstances connected with the discovery of the patient.

ON THE METHODS OF LIFTING AND CARRYING THE INJURED

People frequently meet with accidents or are taken suddenly ill at a distance from their own homes, or from a hospital, and it then becomes necessary not only to render *first aid*, but also to see that the patient is conveyed safely and without further injury to his home, or at any rate to the nearest shelter.

Whether or not this proves a difficult task will depend on the nature of the injury, the locality in which the accident happens, the number of people available who are competent to help, and upon the appliances which can be obtained.

The principles of transport are to keep a patient *safe* whilst he is being carried, and, as far as possible, to carry him in the way that is most *comfortable* for him in his condition. Cases of severe injury, such as fractures of the skull or of the thigh, must always be carried in the *lying down position*, and for this purpose a stretcher of some sort must be obtained, or the patient with or without the stretcher might have to be carried in some form of wheeled conveyance or ambulance waggon; but if the injury be not so severe, or one in which the lying down position is not absolutely necessary, the patient may with help be able to walk home, or he may be carried without the aid of a stretcher, consequently the modes of transport are—

1. By bearer.
2. By stretcher.
3. By waggon.

In the following pages an endeavour is made, with the help of photographs, to show how an injured person may be carried with safety, and with as little fatigue as possible to the helpers, by one, two, and three bearers.

One Bearer.—In cases where the injury is not very severe, and the patient can walk, one person can give considerable assistance in the following manner: Standing at the patient's side, say his right, and facing in the same direction, the bearer passes his left arm across the patient's back, and places his hand firmly on his left hip. The

patient passes his right arm behind the bearer's neck and lets the hand fall well over to the front of his right shoulder, where it is grasped firmly by the bearer's right hand. This will be found an admirable way of supporting a partially injured person; and further, should it be necessary, as for instance, where there is an inequality in the road, the bearer, by placing his left hip behind the patient's right, can easily lift the latter off the ground and carry him over the rough place. One word of caution only being necessary, and that is, that in going down hill the patient must be held firmly, as there is a risk of his tripping and falling forwards.

When the patient is conscious but unable to walk he may be carried in the bearer's arms like a child, or the bearer may carry him on his back; in both these methods the patient helping, if possible, by putting his arms round the bearer's neck. The easiest way to get the patient on to the bearer's back, when the former cannot help in any way, is to get him into the sitting position, with his legs spread widely apart in the first instance; next the bearer crouches down between the patient's legs with his back to him and grasping his wrists draws his arms well forward over his shoulders—the bearer by stooping forward can now get the patient on to his back and it only remains for him to gradually resume the upright position and carry the patient "pick-a-back."

When the patient is *unconscious* it is sometimes a very difficult undertaking for one person to remove him, it being physically impossible for an ordinary man to lift a full-grown person directly off the ground, but this difficulty may be overcome in the following manner.

The bearer turns the patient over on to his face, with the arms lying close beside the body, and taking up his position at the head, stoops down and grasping the shoulders firmly (Fig. 23) lifts the patient into the kneeling position, with the body resting on his left thigh (Fig. 24). The patient is now lifted into the standing position, and supported by the bearer, whose arms pass under the shoulders, and grasp the body firmly (Fig. 25).

Having reached this stage, the bearer now stoops down and places his left shoulder against the patient's stomach, grasps his left wrist with his right hand, and draws the arm across the back of his neck well over his right shoulder to the front of his chest; he at the same time passes his left arm round the patient's left thigh and stands up; the patient's body now falls across the bearer's shoulders and is balanced there, and it only remains for the latter to grasp the patient's left wrist with his own left hand, thus freeing his right hand, and at the same time locking the patient's body in such a manner that it

cannot fall either backwards or forwards (Fig. 26). In descending a ladder, the bearer may let go the patient's hand, and have both his hands free to grasp the sides of the ladder. This is the *fireman's lift*, and is well worth practising, it being the easiest and safest method by which one bearer can remove a helpless person.

Two Bearers.—When there are two persons available, it is of course very much easier to lift an injured man and carry him for a considerable distance, and they may adopt any of the following methods.

1. Fore and aft carry.
2. Two-handed seat.
3. Three-handed seat.
4. Four-handed seat.
5. The Human Stretcher.

The first two methods mentioned are the most suitable for the removal of *unconscious* patients, or for those whose arms are injured. The three- and four-handed seats are best for those who can support themselves by putting their arms round the bearers' necks. In describing the different methods the bearers will be spoken of as No. 1 and No. 2.

Fore and Aft Carry.—Having got the patient into the sitting position, bearer No. 2 passes his arms under the patient's shoulders, and locks his hands over his chest. No. 1 places himself between the patient's legs, with his back to him, and supports a thigh under each arm. Everything being ready, the bearers rise together, No. 2 giving the time. The patient lies in the position depicted in Fig. 27.

Two-handed Seat.—To form the two-handed seat, the bearers stand half-facing each other, and lock their right and left hands, palm upwards, or hook their fingers, to form the seat: with their other hands they firmly grasp each other's shoulders, their arms forming the support for the patient's back (Fig. 28). To lift the patient on to the two-handed seat, No. 1 stands on the right of the patient in a line with his hips, and No. 2 on the left. Both bearers kneel down on the knee that is nearer to the patient's feet, and get him into the sitting position, and support his back with their other knees. They then lock their right and left hands under his thighs, and grasp each other's shoulders firmly with their other hands (Fig. 29), thus supporting the patient's back. They stand up together—No. 1 giving the time, and the patient lies as seen in Fig. 30. If the patient has to be carried some considerable distance, the bearers will find that there is less strain on the hands that form the seat if they fold a handkerchief diagonally—knot the ends firmly, forming a ring, and grasp this rather than each other's hands, as they are usually directed to do.

Three-handed Seat.—This and the following method are only suitable for patients who can raise themselves and do not need to be lifted off the ground. To form the seat, the bearers stand half-facing each other. No. 1 standing on the right of the patient, grasps his own left forearm with his right hand, knuckles upwards, and the left forearm of No. 2 with his left hand. No. 2 grasps the right forearm of No. 1 with his left hand, and completes the seat; and further, places his right hand on the left shoulder of No. 1 to form the support for the back (Fig. 31). Or No. 2 disengaged may be used to support an injured limb. The bearers then lower their hands sufficiently to allow the patient to take his place on the seat, the latter supporting himself by placing his arms round their necks.

Four-handed Seat, or sedan chair, is the most comfortable of all the seats for the patient, and as his weight is distributed over all the four arms that go to make it, it is also the easiest for the bearers. To form it the bearers stand facing each other, and they each of them grasp their *own left forearms* with their right hands, the back of the hands being upwards, and each other's *right forearms* with their left hands (Fig. 32), thus forming a square seat. To get the patient on to the seat, the bearers stoop till it is low enough for him to sit on it—he supporting himself further by placing his arms round their necks.

The Human Stretcher.—This is a modification of the two-handed seat, which is useful for lifting and carrying a patient in the recumbent or semi-recumbent position.

1.—Two bearers face each other and stoop, one on each side of the patient. They clasp their left hands beneath the patient's hips in the manner of shaking hands.

2.—The bearer on the patient's left passes his right hand and forearm under the patient's head, neck and shoulders.

3.—The bearer on the right passes his right hand and forearm under the patient's legs.

4.—The bearers rise together and carry the patient, feet foremost, by short side paces (Fig. 34A).

Three Bearers.—When three bearers are available, and the injury is situated in the lower extremity and no stretcher is obtainable, two of the men lift the patient by the two-handed seat, already described, whilst the third takes charge of and supports the injured limb in the manner illustrated in Fig. 33.

When members of ambulance classes are being instructed in the removal of injured persons by hand-seats, the following form of drill, taken from "The R.A.M.C. Training," published by H.M. Stationery Office, should be adopted :—

"The bearers will be formed up in double rank and numbered. Odd numbers, Right Files. Even numbers, Left Files.

"1.—On the command 'Form Two-handed Seats,' the right files turn to the left, the left files turn to the right.

"2.—The right files bend the fingers of the right hand at the second joint, back of the hand uppermost. The left files bend the fingers of the left hand at the second joint, back of the hand downwards. The right and left files hook the hand together, each placing the disengaged hand upon the other's hip. On the command, 'Files Right and Left—Turn,' the files resume the position of attention and turn in the original direction.

"Substituting 'Three-handed' and 'Four-handed' for the words 'Two-handed,' the formation of the other forms of hand-seats are gone through in the same manner.

"To practise the members in the lifting, lowering, and carrying by hand-seats, a number of patients should be provided and directed to *stand* when the exercise is in three- or four-handed seats, but for two-handed seats they will be directed to sit on the ground. On the command being given, 'Collect Wounded,' each right and left file will double up to its patients, right files to the right and left files to the left of patients, and if to be carried off by two-handed seats, they will kneel on the knee nearest the patient's feet, and form the two-handed seat beneath his thighs, as already described, the bearers rising steadily together, lifting the patient off the ground. On the word 'Advance,' the bearers step off, the right files with the *right* and the left files with the *left* foot, marching by a side step in which the feet are alternately crossed, one before the other. On the word 'Retire,' the bearer to right of patient *marks time*, the left bearer wheels round, both moving on when square. On the word 'Halt,' the whole company halts. On the command 'Lower Wounded' being given, the bearers kneel and *gently* place the patient in a sitting posture on the ground and stand up, still facing inwards. On the command 'Squads, Fall in,' they will fall in in their original positions."

THE CONVEYANCE OF INJURED PERSONS ON STRETCHERS

In a large number of cases the injury to the patient is of such a nature that he must of necessity be carried in the *lying-down* position, whilst in others the distance he has to be conveyed is so great as to render it impossible for him to be carried by hand-seats. Under these circumstances some form of stretcher must be employed. A stretcher is a portable bed, which is made *light* enough to be carried

By Courtesy of St John Ambulance Association

FIG 23.—FIREMAN'S LIFT (1)

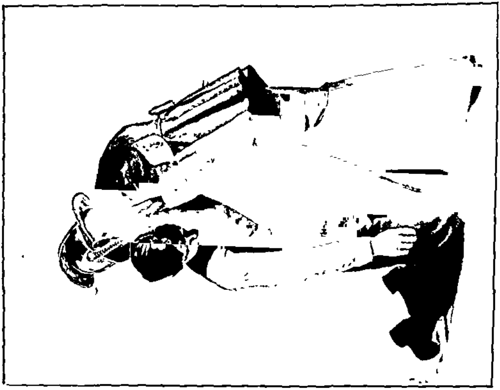


FIG 24.—FIREMAN'S LIFT (2)

By Courtesy of St. John Ambulance Association.

FIG. 25.—FIREMAN'S LIFT (3).

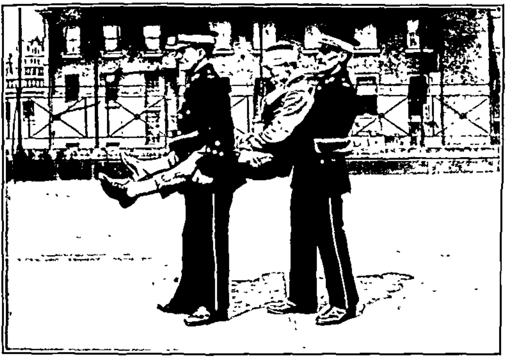
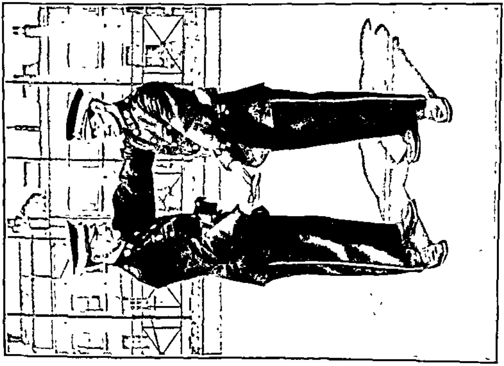


Fig. 27 —Fore and Aft Carry.



By Courtesy of St John Ambulance Association

Fig. 28 —Two-handed Seat.

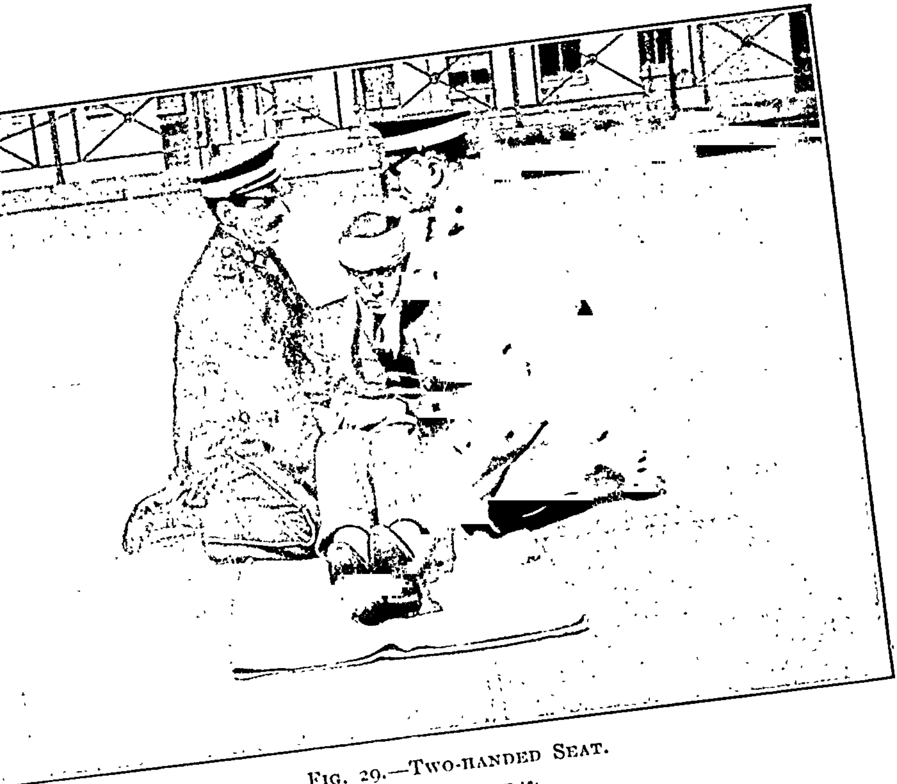
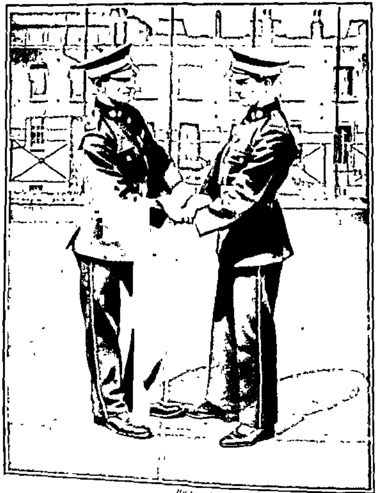


Fig. 29.—Two-handed Seat.
Preparing to Lift.

By Courtesy of St. John Ambulance Association.

Fig. 30.—Two-handed Seat.

conscious.



By courtesy of St John Ambulance Association

FIG. 32. FOUR-HANDED SEAT

FIG. 31.—THREE-HANDED SEAT.

By Courtesy of St. John Ambulance Association.

...ED SEAT.

FIG. 33.—THREE BEARERS.

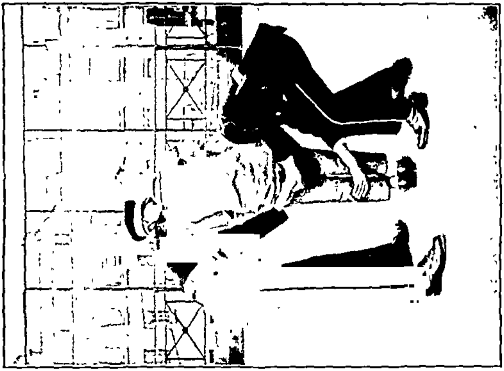
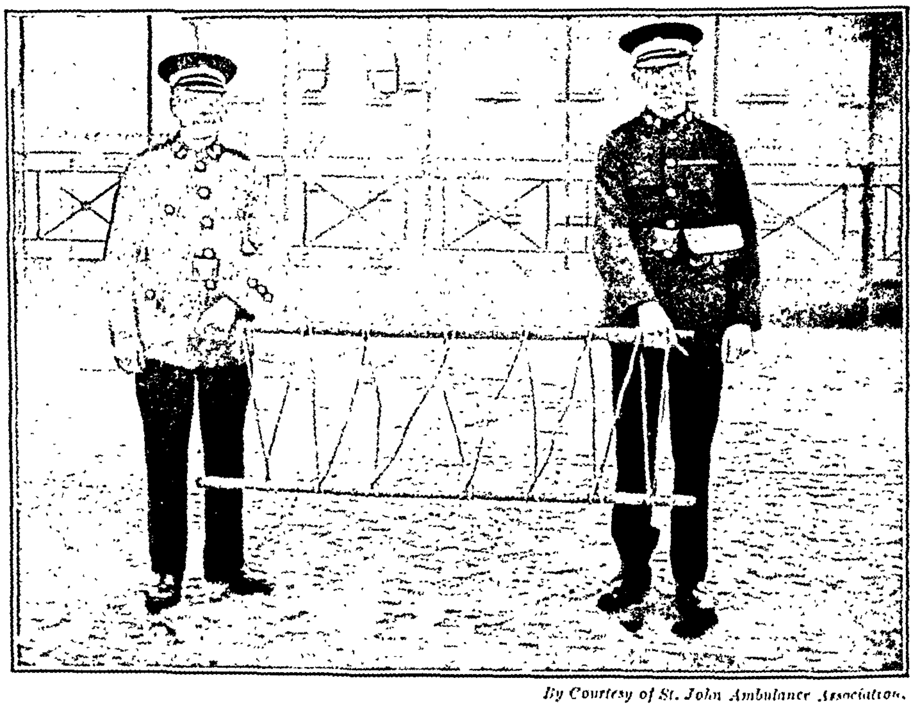


FIG. 34a.—THE HUMAN STRETCHER.

By Courtesy of St John Ambulance Association

FIG. 35.—POLE AND RUG STRETCHER.

FIG. 36.—LOADING STRETCHER. TWO BEARERS.



By Courtesy of St. John Ambulance Association.

FIG. 37.—POLE AND ROPE STRETCHER.

Fig. 38.—Coat and Pole Stretcher.

By Courtesy of St John Ambulance Association

Fig. 39.—Prepare to lift Wounded (2)

FIG. 40.—TAKE POST AT LEFT OF WOUNDED (1).

By Courtesy of St. John Ambulance Association.

FIG. 41.—LIFT WOUNDED (3).

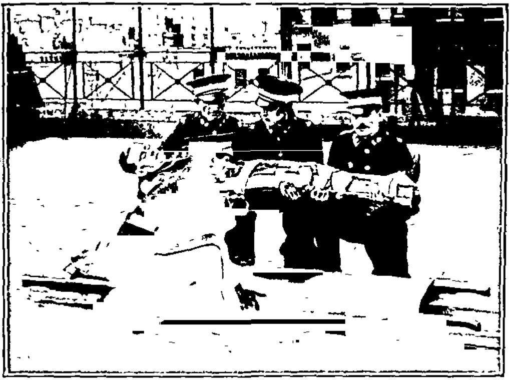
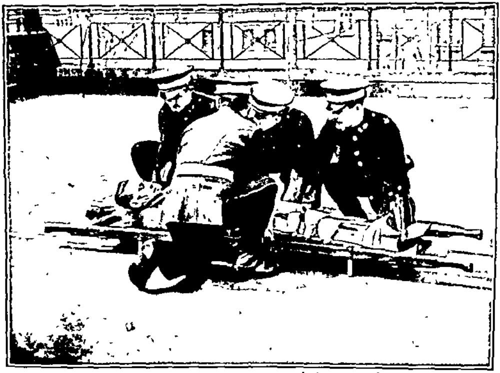


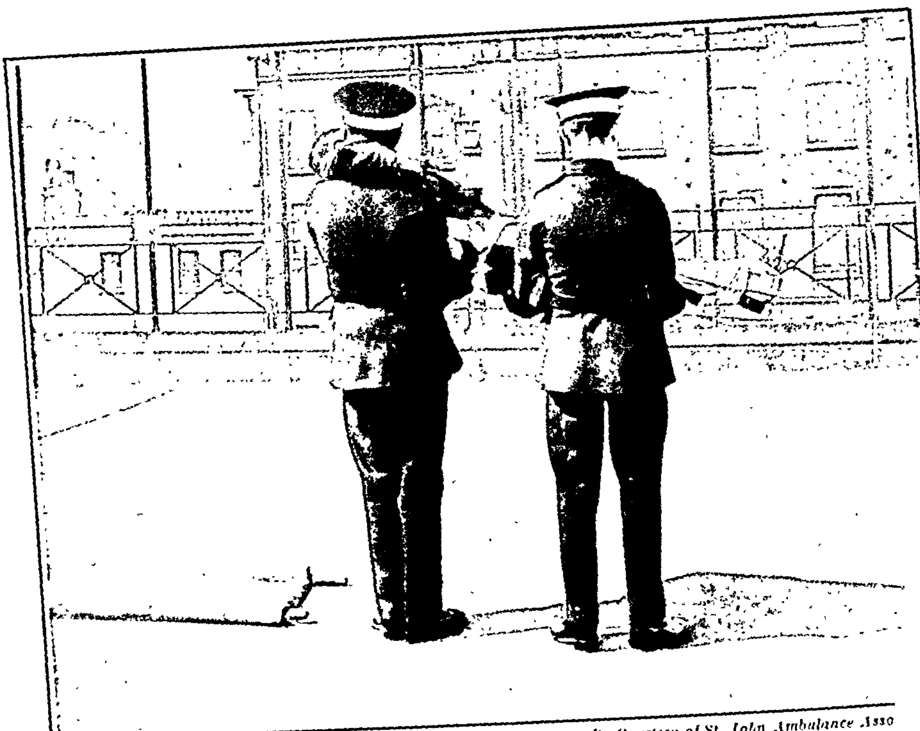
FIG. 42.—PLACING STRETCHER BENEATH WOUNDED (4)



By Courtesy of St John Ambulance Association

FIG. 43.—LOWER WOUNDED (5)

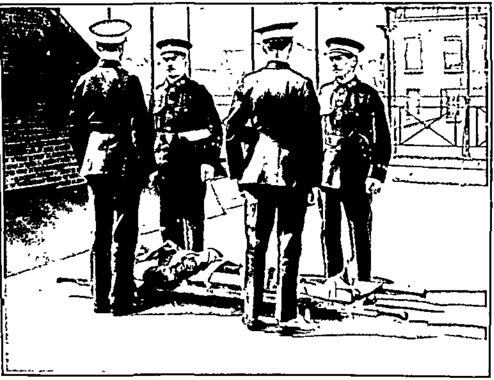
FIG. 44.—MARCH! (6).



By Courtesy of St. John Ambulance Asso

.. .c —LOADING STRETCHER WITH TWO BEARERS.

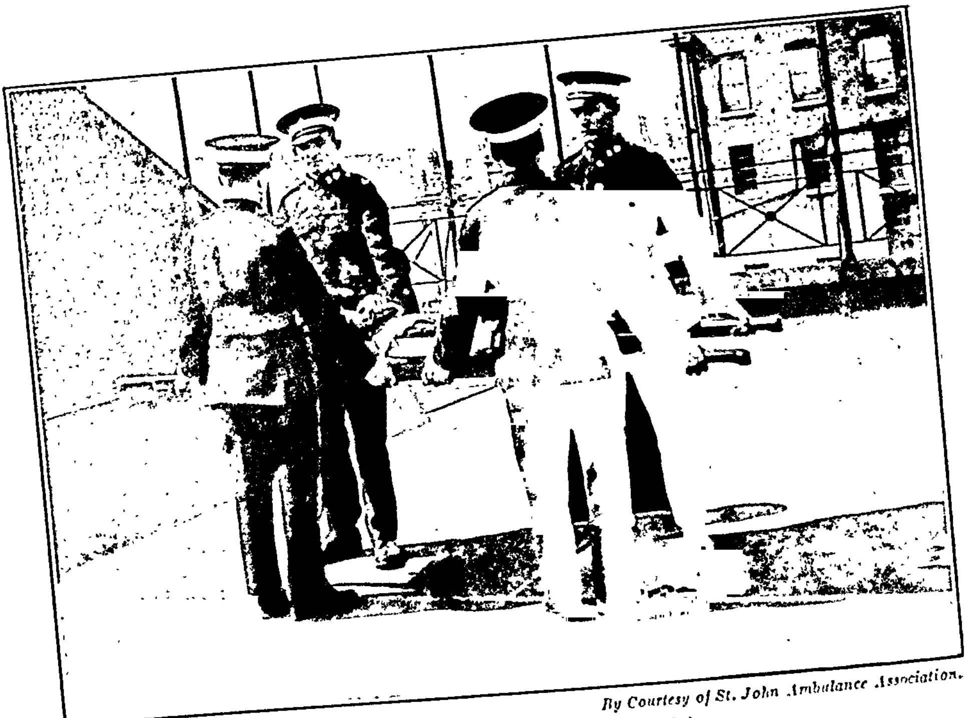
FIG. 47.—LOADING STRETCHER. THREE BEARERS. POLE AND RUG STRETCHER (7).



By Courtesy of St John Ambulance Association

FIG. 49 —FOR LOADING. STAND TO STRETCHER (1)

FIG. 50.—FOR LOADING. PREPARE TO LIFT (2).



By Courtesy of St. John Ambulance Association.

FIG. 51.—FOR LOADING. LIFT (3).

by two men, with a patient lying upon it, and *strong* enough to bear the weight of the patient. There are many varieties of stretcher in use, but that most used is the "Furley" Stretcher.

The "Furley" Stretchers.—The "Furley" Stretchers are of three patterns, viz., "Ordinary," "Telescopic-handled," and "Police." In general principle they are alike, the component parts being designated the poles, handles, jointed traverses, runners, bed, pillow sack and slings.

The Ordinary Stretcher is 7 feet 9 inches in length, and 1 foot 10 inches wide. The bed is 6 feet in length, and the handles 10½ inches. The height is 5¾ inches. The weight is 21 to 22 lbs. At the head of the stretcher is a canvas overlay (the pillow sack), which can be filled with straw, hay, clothing, etc., to form a pillow. The pillow sack opens towards the head, and its contents can therefore be adjusted without undue disturbance of the patient. The traverses are provided with joints, for opening or closing the stretcher. The Telescopic-handled pattern is very similar, but the handles can be slid underneath the poles, thus reducing the length to 6 feet. This arrangement is of great value when working in confined spaces, or when a patient has to be taken up or down a narrow staircase with sharp turns. The Police stretcher is similar to the Ordinary pattern, but is more strongly made, and has, in addition, straps for securing a refractory patient.

When closed, the poles of the stretcher lie close together, the traverse bars being bent inwards, the canvas bed neatly folded on the top of the poles and held in position by the slings which are laid along the canvas, and secured by a strap, placed transversely at the end of each sling, being passed through the large loop of the other, and round the poles and bed.

When an accident occurs in the narrow workings of a mine, in the hold of a ship, or in a sewer, it frequently happens that the length of the stretcher or the narrowness of the passage renders it impossible to carry the stretcher horizontally. To overcome this difficulty some stretchers are made with telescopic handles, whilst others are constructed to permit of the patient being carried in a *vertical* position. Amongst the best known of the latter form are Furley's Lowmore Jacket, in use in the pits at Lowmore, near Bradford, and the Hinged Pit Stretcher of the St. Andrew's Ambulance Association, which admits of the patient being drawn up to the pit mouth in a sitting position if necessary.

The Neil Robertson *Stretcher,* used in the Royal Navy, has been devised for *safely moving* the *wounded* out of difficult places inaccessible to the *ordinary stretcher* with stiff poles; it envelops the wounded man in a *protecting,* but somewhat flexible case, and can be

slightly bent in turning corners and when being hoisted up from the stokehold; it is made of stout canvas 65 inches long, cut into shapes to fit the different parts of the body, and secured by canvas straps. The stretcher is stiffened by bamboo slats sewn to the canvas. There is a central backbone of stout rope passing along the under surface; this has two beckets on either side, which can be used as handles for carrying or for securing tackles when slung. At the head the rope ends in a rope grommet, which takes extra security from two brass eyelets let into the canvas. At the foot the rope ends in a galvanised iron ring, which is also secured to the canvas.

In towns, and districts where the roads are good, and an ambulance is not available, the quickest and least fatiguing method of removing injured persons is by means of the wheeled litter. It consists of two distinct parts—an ordinary stretcher such as has been described, and a wheeled support, upon which the stretcher is placed and fixed. The stretcher being detachable, it is placed on the ground, and the patient laid upon it in the ordinary way. It is then lifted and placed on the support, and one man can easily push it along. An awning completely shelters the patient.

IMPROVISED STRETCHERS

In some circumstances no regular stretcher can be obtained, and it then becomes necessary to *improvise* one, and the material from which it is constructed will depend on the *locality* in which the accident occurs. Illustrations of three varieties of improvised stretchers are given. Fig. 35 shows a wounded man being carried on a pole and rug stretcher. When rifles are used, they must in the first place be *inspected*, and, if found to be loaded, the cartridges withdrawn and the magazines emptied. Next, "spread a blanket on the ground; lay two rifles (fitted with fixed bayonets protected by their bayonet scabbards) parallel to one another, each ten inches from the centre of the blanket, both muzzles pointing to foot of stretcher, trigger guard outwards; turn up a fold of the blanket, six inches wide, over the ends of the butts; fold the right side of the rug over the rifle on that side to the rifle on the opposite side, and then similarly fold the left side. A stretcher is thus formed, consisting of three folds of blanket, the end at which the butts are being the head end. It is lifted and carried in the manner laid down for carrying stretchers when loading waggons" ("Manual of Stretcher Drill"—Alex. Napier, M.D., V.D.).

Another stretcher may be made in exactly the same manner, poles being substituted for the rifles.

Fig. 37 illustrates the pole and rope stretcher, which is made with two poles—any poles of sufficient length and strength will do equally well—and a long strong piece of rope, which is wound from side to side alternately round each pole, and two pieces of wood may be fastened at each end to keep the poles apart.

Fig. 38. The pole and coat stretcher is made by taking two coats, or, what is better, a great-coat and a coat, and through their sleeves, which are turned inside out, passing two poles. The coats are then buttoned down the middle and pinned to each other where they meet, when the stretcher has the appearance shown in the illustration, where, however, two short lengths of wood were tied to the ends of the poles to act as traverses.

Whilst the foregoing examples of improvised stretchers have been given as indications of what may be done, it must be clearly understood that there are many other expedients by means of which the difficulties which arise when no proper stretcher is obtainable may be overcome. In towns—doors, shutters, ladders, &c., may be converted into comfortable stretchers by spreading mattresses and rugs over them; whilst in the country, gates and hurdles are always available, and with one or other of these, together with a blanket and some straw, efficient stretchers can readily be made. Much, however, must always depend on the ingenuity displayed by the workman and, of course, on the appliances at his command. Always test an improvised stretcher before using.

STRETCHER DRILL

For the efficient working of a stretcher, four is the full complement of bearers required; three, however, can manage almost as well, provided the distance the patient has to be carried is not very great; and frequently, indeed, two men are called upon to do the work of four, which, of course, renders the task much more difficult. Assuming that an accident has occurred—in a factory, for instance—and that four men have been told off to undertake the removal of the patient: one of them takes command of the party and calls himself "No. 4," the others being designated 1, 2 and 3 respectively. Having obtained the stretcher, which is closed, No. 4 directs No. 1 to take the foot end of the stretcher and No. 3 the head end. They grasp both handles with their right hands and hold them at the full extent of their arms, with the rollers directed to the right. No. 2 places himself midway between No. 1 and No. 3, and No. 4 one pace directly behind No. 3. In this order they carry the stretcher to the immediate vicinity of the scene of the accident, and No. 2 and No. 4 attend to

patient. No. 1 and No. 3 proceed to *prepare* stretcher by undoing the straps which fix the canvas, separating the poles and straightening the traverses. If there is sufficient room, the stretcher is now placed in a line with the patient, its foot end being one pace distant from his head; but if this cannot be managed, it must be placed parallel to him on one or other side. The stretcher being ready, No. 4 now gives the direction: "Take post at patient." Nos. 1, 2 and 3 take up their position on the left, No. 1 halting opposite the knees, No. 2 at the hips, and No. 3 opposite the shoulders, No. 4 facing No. 2 (Fig. 40).

The command is next given by No. 4, "Prepare to lift wounded," and all the bearers kneel on the left knee (Fig. 39), and No. 1 passes his hands and forearms under the patient's legs, with his hands wide apart. Nos. 2 and 4 pass their hands and forearms under his hip and thighs, whilst No. 3 passes his left arm across the patient and gets his right hand under his shoulder. The next order given is "Lift wounded," and all the bearers *acting in unison*, and, taking care to maintain the patient's body in the horizontal position, *slowly* lift the patient off the ground, and rest him on the knees of Nos. 1, 2, and (Fig. 41). No. 4 then leaves the patient, doubles round to the stretcher, an and grasping a pole by its centre in each hand, lifts the stretcher, and places it beneath the patient (Fig. 42), then kneels and again assis in supporting the patient. On the word "Lower wounded," the patie is lowered slowly and placed gently on the stretcher, the horizon position of his body being maintained throughout (Fig. 43). T bearers then disengage, and proceed to make the patient as comforta and secure as possible before lifting the stretcher, the position in wh he is to lie depending upon the *seat of the injury*. In cases of frac of the lower extremity, the patient's body should be inclined tow the *injured side*, as giving more stability to the limb, folded rug coats being used to raise and support the sound side. When injury is situated in the upper limb, the patient should be place his back or inclined to the *uninjured side*. In injuries affectin head, care should be taken that the wound does not press agains pillow. In wounds of the chest, the body should be inclined to the *injured* side, as this position supports the injury, and also the patient to breathe more freely with the sound side of his In wounds of the abdomen, the patient should lie on his bac his knees bent, and supported in that position by a folded coat being placed under them.

Whatever the situation of the injury, it must be seen to t *head* is lying comfortably, neither too high nor too low.

The patient having been settled comfortably, the bear proceed to lift the stretcher, and do so in the following ma

No. 1 stands between the handles at the foot of the stretcher with his back to the patient, No. 3 stands between the handles at the head, facing the patient, and Nos. 2 and 4 take up their positions on each side of the stretcher in line with the patient's hips.

On No. 4 giving the orders "Prepare to lift stretcher," Nos. 1 and 3 stoop down and firmly grasp the handles; "Lift stretcher," they rise slowly together, lifting the stretcher; No. 3, or the man at the head, carefully taking his time from No. 1, the man at the foot, and keeping the stretcher perfectly level. On the word "March," Nos. 1, 2, and 4 step off with the *left* foot, No. 3 with the *right*, and in marching the bearers take short paces of twenty inches, have their knees bent, and raise the feet off the ground as little as possible (Fig. 44)—the object in Nos. 1 and 3 breaking steps being to prevent the tendency to *roll*, which would be communicated to the stretcher were they to march in step, whilst the short paces with knees bent lessens the up and down motion of the stretcher. In addition to the above rule, the following must also be carefully observed in marching with a loaded stretcher:—

1. The patient must always be carried *feet first*, except (*a*) in going *up hill*, when he is to be carried head first, and (*b*) in going down hill with a patient suffering from a recent fracture of the thigh or leg, who must be carried *head first*, the stronger and taller bearer being down hill.

2. The stretcher should, as far as possible, always be carried in the *horizontal* position, one or other of the bearers raising or lowering his end of the stretcher according to the condition of the road.

3. No attempt must be made to carry a patient over a high wall or fence. An endeavour should be made to break a passage through, and if this proves impracticable he must be carried round to some opening which already exists.

4. In crossing a ditch the stretcher is in the first instance laid on the ground near the edge. Nos. 2 and 4 will stand in the ditch on either side of the stretcher relieving No. 1, who should now be on the other side ready to receive it. Nos. 2 and 4 should now relieve No. 3, who will cross the ditch, Nos. 2 and 4 easing the stretcher across ready for Nos. 1 and 3 to resume their positions and advance.

On arriving at their destination No. 4 gives the order, "Lower stretcher," and the bearers slowly and gently lower it to the ground. In lifting the patient off the stretcher the bearers take up the same position as when lifting him off the ground, and lift him on to their knees. No. 4 removes the stretcher, then resumes his position at the side of the patient, and helps to support him. Should it be necessary to lay him on a bed, they stand up, with the patient resting on their

arms, march by short side steps, in which the feet are alternately crossed, to the side of the bed. No. 4 goes to the opposite side and assists in lowering him on to the bed.

Loading and Unloading a Stretcher with Three and Two Bearers.—When only *three* bearers are available, the stretcher is placed with its foot end one pace from the patient's head, and in the same line as his body. One bearer then takes up his position on the *injured side* in a line with the patient's knees, and passing his arms under the legs and thighs, raises and supports the lower limbs. The other two kneel on opposite sides of the patient in a line with his hips, and passing their arms under his back and thighs, lock their fingers to get a firm grip, and prepare to raise the trunk. Acting in unison, and maintaining the horizontal position of the patient's body, they lift him, and rise to the erect position (Fig. 47). They then carry the patient over the *foot* of the stretcher and lay him on it. When removing the patient, he must be lifted and carried over the *head* of the stretcher.

It may here be remarked that in loading *improvised* stretchers, they should always be placed at the patient's head in the same line with his body, as indicated in Fig. 47.

When only *two* bearers are available, the stretcher must again be placed at the patient's head in the same line as his body, and to lift the patient on to it two methods are suggested. By the one method, the bearers place themselves on the *injured side*, and one, placing himself in a line with the knees, supports and raises the lower limbs, whilst the other, placing himself in a line with the hips, and aided by the patient if possible, raises the trunk, the horizontal position of the body being maintained, as shown in Fig. 48. The patient must be carried head foremost over the foot of the stretcher and laid upon it, and in removing him from the stretcher he must be lifted and carried head foremost over the head of it. By the other method—which is most suitable in cases where a long splint has been applied—the patient is turned over on to his *sound* side, and the bearers, standing astride of him, one in line with his knees, and the other near his shoulders, stoop down and encircle the patient's body with their arms, locking their fingers to get a firm grip, the patient assisting by passing an arm round the leading bearer's neck. The patient is lifted clear off the ground and carried on to the stretcher, which must be placed at his head in the same line as his body (Fig. 36).

Conveyance of Injured Persons by Ambulance Waggons, Country Carts, &c.—All towns, and many country districts, are now provided with ambulance waggons for the rapid and comfortable removal of injured persons. Figs. 45, 46 may be taken as the

types of all civil ambulances. The first-mentioned has accommodation for one patient and three convalescents, one attendant inside and one beside the driver. It is of light weight—being drawn by one horse—has sensitive springs, and the wheels are tyred with indiarubber, jolting thus being reduced to a minimum.

To load an ambulance waggon with the patient on a stretcher, the bearers halt a stretcher-length from the tail-board of the waggon and lower the stretcher. No. 2 will place himself opposite No. 3 and No. 4 opposite to No. 1 facing each other (Fig. 49). No. 4 gives the command to load, the bearers stoop, grasp the stretcher with hands wide apart, palms uppermost (Fig. 50), and rise slowly—holding the stretcher at the full extent of the arms (Fig. 51); they will then wheel round to

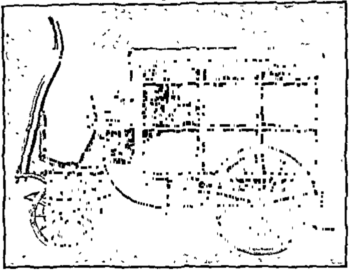


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FIG. 45.—Ambulance Waggon.

the right with a side step crossing the feet in front, halt one pace from the tail-board and opposite the compartment to be loaded. The stretcher will then be lifted on a level with the floor of the upper compartment, placing the runners on it. Nos. 1 and 3 raising their end of the stretcher, it is then pushed home, Nos. 2 and 4 making way for the stretcher to pass between them. When loading the upper compartments the orderly will remain in the waggon and push the stretcher into its place until the runners are properly fixed, assisted if necessary by the bearer nearest the centre of the waggon. The stretcher will then be secured by means of the straps.

To Unload a Waggon.—*Two of the bearers, Nos. 1 and 4,* grasp the handles of the stretcher with their right and left hands respectively, and pull the stretcher out of the waggon, until the head end of it rests upon the edge of the floor. Nos. 2 and 3 now grasp

the handles at their end, and all the bearers, supporting the stretcher in the manner described for loading, lift it clear of the waggon, and then lower it to the ground, preparatory to lifting it again as in marching.

Where no proper ambulance waggon is available, lorries, country carts, &c., may be utilised for the conveyance of injured persons, either with or without a stretcher. In both cases the floor of the conveyance must be thickly covered with straw. To load the cart with a patient on a stretcher, the same methods are adopted as in loading a proper waggon, up to the point where the foot end of the stretcher is resting on the edge of the floor of the waggon; after this, Nos. 1 and 2, instead of standing aside and allowing the stretcher to be

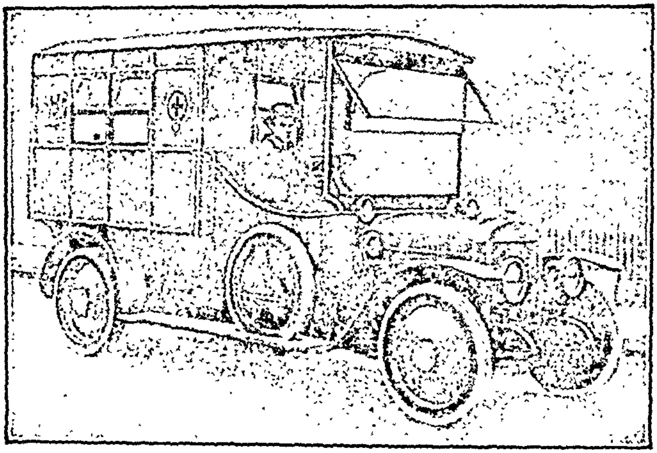

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FIG. 46.—Ambulance Cab.

pushed into the cart by Nos. 3 and 4, climb into the cart and help to *lift* the stretcher into it, a step rendered necessary by the straw which covers the floor of the waggon. Having placed the stretcher in the position most comfortable for the patient, it should be fixed by ropes to the sides of the cart to keep it steady.

Where no stretcher is available, the patient must be lifted by one of the forms of "hand-seat," or in the manner described for lifting a wounded person on to a stretcher, and, on arriving at the footboard, No. 4 climbs into the cart and supports the patient's head and shoulders, and thus helps the other bearers to lift him into the cart and to lay him in the most comfortable position.

The Conveyance of Injured Persons by Railway.—It very frequently happens that sick and injured persons have to be conveyed considerable distances by train; and, in cases where the lying down position is imperative, one of the difficulties attendant on this mode

of transport is, that ordinary stretchers are too broad to permit of their being passed through the doors of railway carriages without being tilted to one side, a very dangerous procedure.

The stretcher may be laid on the *floor* of a compartment, or on that of a saloon carriage, guard's van or luggage van, but ordinarily it is placed diagonally in a compartment, with the head resting on one seat and the foot on the other, thus allowing room for the attendants to sit on the remaining two corner seats of the compartment; but by placing two stout planks of wood across the interval between the seats of a third-class compartment, *two* stretchers can be placed in one compartment, resting partly on the seat and partly on the planks of wood, and leaving room between the stretchers for the attendants to sit on the planks. An endeavour should always be made to place a stretcher in a compartment near the middle of a train, as here the oscillation will be least felt. The loading and unloading of stretchers on to railway carriages must be carried out in the manner described for doing so on to country carts (*q.v.*).

If the patient is to travel in an ordinary railway carriage, a good method to adopt is to place upon the stretcher a canvas bed having wide hems down both sides, through which two poles can be passed. The patient can then be lifted off the ordinary stretcher and placed upon the seat of the railway carriage. The patient can be removed in the same way by lifting him in the canvas and pole stretcher and placing it on an ordinary stretcher on the platform.

Where the lying-down position is not absolutely necessary, patients may be conveyed by train in the sitting position, provided of course that their injuries have been attended to, and splints applied where necessary.

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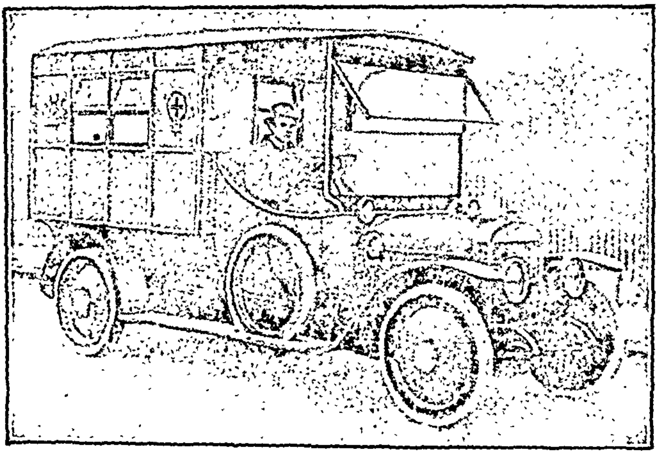

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FIG. 46.—Ambulance Cab.

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SECTION II

THE HEART AND CIRCULATION OF THE BLOOD

[*See Coloured Plate illustrating the Heart at p. 112, also the model of the Internal Organs in Vol. II.*]

In a previous portion of this work the process of digestion was shown to be that which constitutes the foundation of the body's nourishment. The object of this process is that of converting the food into such a form that it can be readily added to and mingled with the blood, which fluid it is destined to renew and repair. The blood, therefore, forms what we may term the common currency of the body, constituting in itself a fluid from which each variety of cell and tissue derives its special form of food by way of repairing the constant waste to which all parts of the body are subject as a result of the work or functions they perform. As we should naturally expect, a tolerably close resemblance exists between the food and the blood on the one hand, and between the blood and the body itself on the other. At the same time it is important to note that each tissue of the body has the power of taking from the blood the particular substances contained in that fluid which are necessary for its growth, development, and repair. We thus discover that the process of nourishing the body is not merely one in which materials contained in the blood are applied to the wants of the frame as such. There is, in other words, a process of manufacture, or as some physiologists have termed it, "secondary digestion," taking place in the tissues of the body, whereby the elements provided in the blood are elaborated into the particular shape and form required for the nourishment of each part.

The Blood.—Having regard to the composition and constitution of the blood as a fluid formed from the food, we may investigate its nature first from the point of view of the microscopist, and secondly,

from that of the chemist. Reference has already been made (vol. i., p. 90) to the blood from the point of view of its containing certain bodies called *white corpuscles*, which discharge important duties in disposing of the microbes or germs gaining admittance to the system. It is necessary, however, to take a wider and more complete view of the blood from the microscopic point of view having reference to its work in the nourishment of the body, and in discharging the duties included in its circulation. When a thin film of blood is viewed, placed between two thin microscopic glasses, it is seen that, instead of presenting the uniformly red appearance familiar to the naked eye, it is essentially *a clear fluid, or at least* a fluid of a light straw colour. Floating in this fluid we see the solid

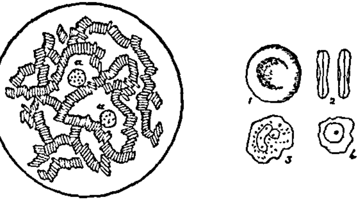


FIG. [illegible] A Thin Film of Blood seen under the Microscope. The Red [illegible]

bodies known as the *corpuscles* of the blood. These are of two kinds, *red corpuscles* and *white corpuscles*. The fluid in which they float, and which is therefore to be typically considered as the blood itself, is known as the *plasma* or *liquor sanguinis*. As blood is ordinarily viewed under the microscope (Fig. 47*a*) the red corpuscles at first are seen to be separated one from the other. Later on they run together and form *rouleaux*, thus resembling piles of coins, the edges of which are turned towards the eye of the observer. It will be understood that the red colour which blood presents to the eye is therefore merely in one sense an optical illusion and not a reality. We have seen that the blood fluid itself is practically clear. The colour of an animal's blood must therefore be derived from the particular kind of corpuscles which float in it. So numerous are the red corpuscles in human blood that the unassisted eye is unable to distin-

guish the clear fluid in which they are suspended. The case of the blood here may be compared to that of water in a ditch in which large numbers of microscopic green plants are contained. Ordinarily viewed, such water appears of a green colour, but on taking up a portion in a glass vessel it is then seen that the water itself is perfectly clear and owes its apparent tint to the numerous coloured bodies floating in it. All back-boned animals, with the exception of the lowest fish, known as the *Lancelet*, possess red blood, the blood of this fish being colourless. Some worms possess green blood owing to the particular colour of their blood corpuscles. In animals such as the oyster, in which no colour is apparent in the blood, only colourless corpuscles exist.

The White Corpuscles.—If the blood under the microscope be more carefully examined, a second series of corpuscles may be noted to float in the fluid. These are the *white corpuscles* or *leucocytes* (Fig. 47*a*, *a*), to which allusion has already been made. They are somewhat larger than the red corpuscles, but are infinitely less numerous. They vary in number at different times of the day and also in different states of body. In some diseases it is of importance for the physician to note whether these white corpuscles exhibit an increase or not. It is known that after food the proportion of white to red corpuscles increases. Thus, whilst before a meal the number of white as compared with red was found to represent 1 white to 1800 red, an hour after food the proportion represented was 1 to 700. Later on the former proportion was approached. In ordinary healthy blood we may assume that about one white corpuscle exists to every 600 or 800 red ones. In diameter the red blood corpuscles of man average the $\frac{1}{3200}$th of an inch, the diameter of the white corpuscles being about the $\frac{1}{2500}$th part of an inch. Variations in size are, however, common. The smallest red blood corpuscle among the quadrupeds is that of the musk deer, which measures the $\frac{1}{12325}$th part of an inch in diameter. In certain members of the frog class the blood corpuscles are extremely large, some of them averaging the 400th part of an inch in diameter. Differences between the red and white blood corpuscles, other than those represented by their size, are to be noted. In the first instance the red corpuscle is coloured, the colouring matter being practically a combination of iron and protoplasm (or living matter) known as *hæmoglobin*. This substance shows a percentage of about four parts of iron in the thousand. We shall presently note the high importance of hæmoglobin in connection with the duties which the red corpuscles are intended to discharge in the frame. When the white corpuscle is more narrowly examined, and when especially acetic acid is brought into contact with it, we find that a *nucleus* or

central particle is plainly seen within this substance. In the larger varieties of white corpuscles more than one nucleus may be perceived. A red corpuscle contains no such central particle, hence, whilst we must regard the white corpuscle as a perfect living cell, the red corpuscle does not attain to that distinction. In shape the white corpuscle (Fig. 47*a*, 3, 4) may be described as of a more or less globular shape, or as they have perhaps been more properly described, their shape is irregularly spherical. The red corpuscle, on the other hand, is hollowed out on each face (Fig. 47*a*, 1, 2). In other words, it may be described as a round biconcave structure, which might in one sense be roughly represented if on each side a coin were somewhat hollowed out in the middle.

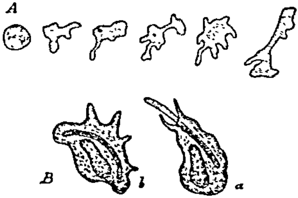


FIG. 48*a*.—*A*, A White Corpuscle moving about through Changes in its Shape. *B*, Two White Corpuscles; one at *a* engaged in attacking a Disease Germ; at *b*, the same Corpuscle is seen having completely invested the Germ.

The Quantity of Blood.—Reference has already been made to the work of the white corpuscles (vol. i., p. 91) in their work of attacking and destroying microbes which gain admittance to the system. It may suffice here, therefore, if we briefly recapitulate the main facts of this work. When blood is observed in certain circumstances under the microscope the white corpuscles are seen to alter and change their shape (Fig. 48*a*, *A*). They move across the field of the microscope in this way through their changes of form. There is no doubt that in all animals such movements are proper and are natural to these bodies. They are known to pass out through the walls of the finer blood-vessels, and to wander through the tissues of the body, an action which, as has been shown in the section of this work devoted to inflammation, takes place very typically in the course of that disease-process. It is in their wanderings through the body, or in

their presence on membranes, where there is a liability to infection by disease germs, that the work of the white corpuscles in destroying the latter is seen (Fig. 48*a*, *B*). We may therefore legitimately compare the white corpuscles of the blood to a sanitary police force which is ever on the outlook to dispose, if possible, of injurious elements and substances which have gained admission to the frame. An interesting calculation has been made with reference to the number of blood corpuscles existing in the human body. It has been possible to compute with fair exactitude that in a little over the $\frac{1}{100}$th part of a cubic inch of blood fluid, more than five millions of corpuscles are contained. Yet another calculation has been made to the effect that if the red blood corpuscles in the blood of an adult were placed side by side they would cover a space or area of 3000 square yards. The quantity of blood in the body naturally varies at different ages. An average calculation sets down the amount at $\frac{1}{12}$th or $\frac{1}{13}$th of the whole body's weight, so that in a man weighing 11 stones the blood in turn might be estimated to weigh about 12 lbs. With reference to what may be called the distribution of blood in the living body, physiologists teach that in the heart, lungs, and blood-vessels, at any given moment, one-fourth of the amount of blood is contained. The same quantity is regarded as being contained in the liver, and equal amounts in the muscles of the body and in the other organs and tissues.

Chemical Composition.—When blood is chemically analysed it is found to consist in a hundred parts of 78.5 of water, of corpuscles 13.0, of proteids, or nitrogenous matters, contained in the blood fluid 7.0, of fibrin 0.2, of fat 0.1, minerals 0.6, and of gases and other matters 0.6. When the blood fluid itself is analysed it is found to contain in a hundred parts 90.0 of water, of proteids 9.0, of minerals 0.8, and of fat and other bodies 0.2. Regarding the red corpuscles, their composition gives us of water 68.8 in a hundred parts, of hæmoglobin, or colouring matter, 28.5, of proteids 2.0, of chloride of potash 0.3, of phosphate of potash 0.2, and of other minerals and fats 0.2. Practically we may regard the blood in its ordinary composition as showing very much the same details as those represented in the constitution of muscle itself. With reference to the gases contained in the blood we find that in 100 volumes of blood about 60 volumes of gases are contained. These gases are represented by carbonic acid, oxygen, and nitrogen, but the quantity of oxygen and carbonic acid varies materially according to the purity or impurity of the blood. Thus in pure blood we find 20 volumes of oxygen and 39 volumes of carbonic acid gas. In impure blood on the other hand the quantity of oxygen sinks to from 8 to 12 volumes,

whilst carbonic acid gas is increased to 46 volumes, the nitrogen in each case remaining constant at from 1 to 2 volumes. The importance of these differences will be more readily appreciated when we come to consider the functions of the blood as related to the work of breathing. With regard to the general character of the blood it may be described as an alkaline fluid, the specific gravity of which at 60 degrees Fahr. varies from 1055 to 1062. The average temperature of the blood, as has already been explained in the section dealing with fevers, may be set down at 98.4 degrees Fahr., this average being of course subject to slight variations on either side.

The Clotting of Blood.—It is a well-known fact that blood drawn from the living body into a vessel sooner or later *coagulates* or *clots*. The changes which occur prior to coagulation may be said in one sense to present us with some adequate notion of what may be called the structural composition of the fluid. In the first place if blood taken from an animal be allowed to escape into a vessel and arrangements made for surrounding the vessel by a very low temperature, coagulation is delayed. Naturally the corpuscles forming the heavier part of the fluid fall to the bottom of the vessel, whilst the *plasma*, or fluid of the blood, rise to the top. Later on we should find the underlayer of corpuscles developing a deep red tint, whilst the fluid above would exhibit a colourless or watery appearance. If the blood is subjected to a somewhat higher temperature it then presents the [illegible], the plasma itself becoming of a jelly-[illegible] of blood is believed to be due to the [illegible] a nitrogenous substance known by the name of *fibrin*. If, as an old physician in the reign of Charles I. showed, blood drawn from an animal be agitated or kept in motion by switching it with willow twigs, clotting is prevented, but on the twigs so used strings or threads of *fibrin* in the shape of a whitish, jelly-like substance are found. This fibrin is therefore regarded as the cause of the clotting, seeing that it, so to speak, entangles the blood solids, and causes them to assume a somewhat solid formation. In blood itself fibrin does not seem to exist as such, so that there is no clotting possible, as it naturally circulates in the blood-vessels, whilst when a solution of common salt is added to blood the clotting process is retarded. If blood be simply drawn from the living body into a vessel at an ordinary temperature, we find that clotting takes place quickly, and the vessel is filled with a reddish-looking jelly. Under certain circumstances, however, the corpuscles sinking into the bottom will give the clot a deeper tinge in its lower portion. The white corpuscles, on the other hand, in such a case are usually found at the top of the clot, giving the mass above a dirty whitish appear-

ance. To this condition of the clot the old name of the "buffy-coat" was given. In cases in which the clotting of blood has taken place quickly the separation of the red from the white corpuscles is not accomplished, and the "buffy-coat" appearance is therefore not represented. Later on, blood contained in a vessel is found to become depressed or shrunken in the centre of the mass. In such a case naturally the upper surface of the clot becomes somewhat concave, and the blood is then said to present a "cupped" appearance. During this process of the sinking of the blood clot, a yellowish fluid is pressed out. This is seen around the clot, and constitutes a fluid in which practically the clot may be said to float. To the fluid in question the name of *serum* is applied.

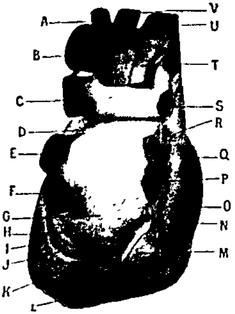
Reviewing now the circumstances of the clotting of blood, we see that ordinary blood as it circulates in the body consists of the fluid or "liquor sanguinis" and the red and white corpuscles. The fluid part of the blood develops serum and fibrin, and the clot practically consists of the fibrin *plus* the corpuscles, whilst the serum, as has been described, left free, appears as a separate element in the clot. The process of coagulation, as has been remarked, does not of course take place naturally in the body, but it is a notable fact that wherever alterations in the structure of blood-vessels takes place, or wherever any foreign substance is introduced into the current of the blood, coagulation may then be favoured. In a common experiment, for example, a thread passed through a blood-vessel will exhibit a coating or layer of fibrin. In the same way, where some part of a blood-vessel or a valve of the heart exhibits any roughness due to disease processes, the fibrin may be, so to speak, attracted thereby. In this case a special danger arises from the fact that if clots be formed in such a manner, they are liable to be carried to different parts of the body, and to give rise to blockage of blood-vessels. It may be mentioned that what has been described as the "buffy-coat" of the blood is well developed in the course of coagulation in the blood of the horse, whilst it is also characteristic of the blood of man in cases where inflammatory elements are present.

The Uses of the Corpuscles.—The functions discharged by the white corpuscles of the body have already been alluded to. It remains to note the duties specially performed by the red corpuscles of the blood, and also to investigate the source of development of each of these solid elements of the vital fluid. The red corpuscles may be typically regarded as the gas-carriers of the blood. It is needful to remind ourselves that the *oxygen* we breathe in from the air and which passes into the blood from the lungs, is a

HEART.

DRAWN FROM ACTUAL DISSECTIONS BY E. BURNET, B.A., London.

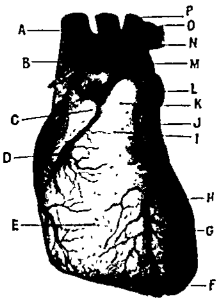
POSTERIOR VIEW.



A. Left Common Carotid Artery
B. Aorta

L. Inferior Surface of Ventricles.
M. Inferior Vena Cava.

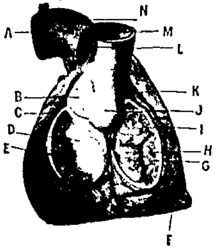
ANTERIOR VIEW



A. Innominate Artery.
B. Superior Vena Cava.
C. Right Appendix
D. Auriculo-Ventricular Furrow
E. Right Ventricle
F. Apex
G. Left Ventricle
H. Inter Ventricular Furrow and Branch of Left Coronary Artery

I. Infundibulum.
J. Left Appendix.
K. Pulmonary Artery
L. Left Pulmonary Artery
M. Aortic Arch
N. Left Innominate Vein
O. Left Sub-clavian Artery
P. Left Common Carotid

BASE OF VENTRICULAR PART (Auricles Removed).



INTERIOR OF RIGHT VENTRICLE.

A. Innominate Artery
B. Left Sub-clavian Artery
C. Left Common Carotid Artery
D. Aortic Arch.
E. Serous Pericardium.
F. Ascending Aorta.
G. Pulmonary Artery

H. Right Auricular Appendix
I. Pulmonary Valve
J. Infundibulum
K. L.O. Segments of Tricuspid Valve
M. Papillary Muscle
N. Moderator Band.

necessary constituent of our food-supply. So important indeed is this element, that without it life would cease as we know in a very short period of time. This oxygen is carried to all parts of the body by the circulation, and as it is a gas which has a great affinity for hæmoglobin (or the colouring matter of the red corpuscles), it is readily taken up by these bodies and by them conveyed through the frame. When, however, the blood has discharged its nourishing functions and has parted with its oxygen it receives from the tissues of the body *carbonic acid gas* (CO_2), which in turn has to be conveyed back to the lungs, there to be excreted into the atmosphere in the process of expiration or breathing out. Pure or arterial blood laden with oxgyen is of a light scarlet colour. When, however, the oxygen has been replaced by carbonic acid gas the blood becomes of a darker hue, and it is this dark coloured blood which is characteristically found in veins. With reference to the development or source of origin of the blood corpuscles, it has been generally assumed that various glands, of which the spleen and tonsils are examples, are concerned in the formation of the white corpuscles of the blood. In the development of the body the first supply of blood corpuscles is found to arise from certain cells represented in the young or embryonic frame. These first corpuscles present a likeness to the colourless corpuscles of ordinary blood but are themselves coloured, and they are also capable of exhibiting the characteristic movements of the white corpuscles, and also of giving origin, by division of their substance, to others. Later on in the development of the body, the liver appears to take part in the development of the corpuscles of the blood, whilst the lymphatic glands and thymus gland, and as has been noted, the spleen also, share in the work. It is at a later stage of the development of the body that we find white corpuscles to appear in the blood. It is a curious fact that the substance known as the *medulla*, that is, the fatty matter or red marrow contained within bones, appears to give rise to red corpuscles, whilst the spleen is also credited with their production. A theory has also been entertained that the spleen is the chief organ in which red corpuscles may be produced by a process of modification of the white ones. This latter view, however, has not received general acceptance from physiologists.

THE CIRCULATION OF THE BLOOD

By the word "circulation" we imply something very different from, say, the flow of water in a river. The term itself indicates that the circulating medium performs a return journey and thus

arrives at the point at which we began to trace the action in question. In a river the water flows onwards to sea or to lake and is seen no more. In the circulation of the blood, however, whilst its individual elements are perpetually being worn out and replaced, the general flow passing outwards for the nourishment of the frame is continued backwards, so to speak, so as to arrive again at any given point in the round.

Uses of the Circulation.—The uses of the circulation are many. In the first place a full supply of blood is required to be sent to every organ and tissue *for purposes of nourishment*. To this we may add that it is by the blood circulated in the young body that *growth is provided for*. In the second place the blood is the source of supply *for the manufacture or secretion of all fluids or other substances necessary for the performance of bodily functions*. It is from the blood supplied to the digestive organs, for example, that gastric juice, saliva, bile and pancreatic juice are manufactured, whilst the tears and the synovial fluid or oily matter that lubricates the joints, equally present us with manufactured products of which the blood represents the raw material. In the next place the circulation of blood undoubtedly *provides for the distribution of heat in the body*, and we have already seen in connection with the functions of the skin how the bodily heat is controlled by the skin structures. Another important duty of the circulation is that of *acting as a kind of drainage system*. The wear and tear of the body which are inseparable features of the work which the body is perpetually performing, is absorbed by the vital fluid from the tissues in the shape of various waste materials, carbonic acid gas amongst them. The blood laden with such waste materials in the course of the circulation is carried to such organs as the lungs, skin, kidneys, and liver, the waste matters being removed by each of these organs and the purification of the blood thus ensured. Finally we have to assume that the blood *is the great source of the energy* which the body exhibits, seeing that it practically represents the original source of power contained in the food. Unless each organ and tissue of the body is supplied with pure blood a condition of health is impossible of maintenance, and this remark holds equally true where we have regard to the heart itself or to the vigour with which brain cells discharge their work of governing and controlling the frame. It has been shown in the first volume of this work how in a disease such as *scurvy* (vol. i., p. 107) an alteration in the quality of the blood may produce serious results, this disease being probably due to the absence from the food of salts or compounds of potash which a proper dietary corrects and therefore tends to cure

the ailment. We can also understand that in a disease such as *anæmia*, popularly known as "bloodlessness," the quality of the blood being altered, especially in the way of a deficiency of the natural amount of iron it should contain, represents a condition followed by the development of disease. The proper quantity of blood also forms a distinct element in connection with the preservation of health. It need hardly be said that the loss of any considerable quantity of blood represents another condition seriously interfering for a time at least with the proper nutrition of the body.

The Apparatus of the Circulation.—The apparatus of the circulation may be said to consist of the *heart* and the system of tubes in connection with it, known as *blood-vessels*. It will be understood that this system of vessels is necessarily continuous, otherwise no possibility of a "circulation" being carried on could exist. It may be well, in the first instance, that the blood-vessels should be first described. Three kinds of blood-vessels exist in the body. These are respectively known as *arteries*, *veins*, and *capillaries*. An artery may be defined as a blood-vessel which is destined to carry pure blood *from the heart to the body*. In a vein, on the other hand, is found impure blood, which is being carried *from the body back to the heart and lungs*. The capillaries are the finest and most minute blood-vessels of the body. They represent practically the last twigs resulting from the branching out of the arteries, and it is in the capillary network of the body that we find veins taking their origin. The course of the circulation, therefore, if we start at the left side of the heart with pure blood issuing therefrom, is through the arteries into the capillaries, then onwards to the veins, and back to the right side of the heart.

The distribution of blood through the body may be compared, in a rough fashion, to the ordinary plan on which the supply of gas is organised. We start with large pipes issuing from the works; these passing continuously into smaller pipes for street supply, whilst the latter in turn exhibit still smaller branches for the supply of houses, and, finally, within the house are found smaller pipes still, for the supply of the rooms. In this way we find the gas supply is naturally spread over a very wide area, and so in the body, the largest blood-vessels are naturally those in nearest proximity to the heart itself; the finest blood-vessels, or capillaries, representing the ends of the various branches into which each artery finally spreads. The obvious reason why, in all parts of the body, we should find these last twigs of the arteries dividing into a network of extremely fine vessels, is found in the need which exists for bringing the blood in contact with the various cells and tissues of the frame. It is through the walls of

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these capillaries that the blood-fluid itself can strain so as to come directly in contact with the parts it is intended to nourish. This particular distribution of blood has already been explained in the section (vol. ii.) dealing with the "Lymphatic System." A perpetual leakage of blood-fluid is taking place through the delicate blood-vessels of our frame, the excess of this fluid being gathered up by the lymphatic or absorbent vessels, and ultimately, as has been described in the section referred to, conveyed back to the blood to assist in renewing and repairing that fluid.

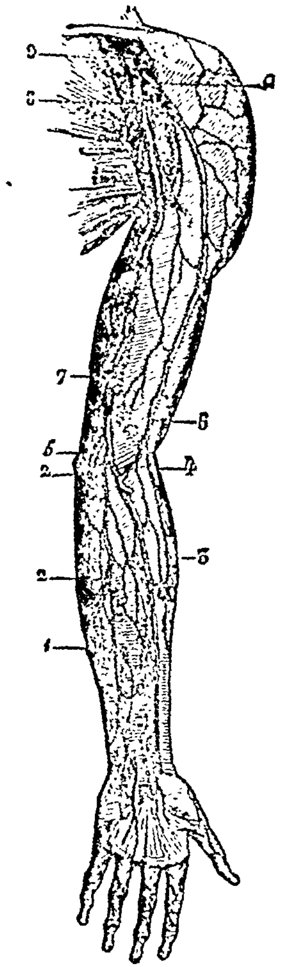


FIG. 49a.—The Superficial Veins of the Arm.

1. Median Vein; 2, Ulnar Vein; 3, Radial Vein; 4, Median Cephalic Vein; 5, Median Basilic Vein; 6, Cephalic Vein; 7, Basilic Vein; 8, Axillary Vein; and 9, its Upper End.

Structure of Blood-Vessels.—The word "artery" is derived from two Greek words, meaning "to hold air." This term was applied by the ancients to these vessels on account of an idea that, because they were found empty after death, their function was to convey air to all parts of the body. In its structure an artery presents us with a vessel whose substance exhibits three coats or layers. The outer coat consists of fibrous tissue, with a certain proportion of elastic fibres. This coating undoubtedly confers a high degree of elasticity upon the vessel. The middle coat is composed of layers of unstriped muscular fibres; but in the larger arteries, in addition to the muscular substance, we also find elastic tissue and fibrous tissue. The innermost coat of the artery is the most delicate of the three. It practically consists of a layer of flattened cells lying on a basement of elastic tissue.

FIG. 50a.- ternal Vein of and its L

With regard to the *structure of veins* (Figs. 49a and 50a), we find in these vessels three coats or coverings. These, however, do present us with the same elastic nature as those found in the a

When an ordinary vein is slit up and examined it is found to possess structures in the shape of valves (Fig. 51*a*), such as are wanting in the arteries. These valves consist of pockets, the mouths of which open towards the heart. They therefore allow the flow of blood to pass easily in the heart-direction; any backflow, on the other hand, being arrested through the filling of the pockets. In cases of enlarged or varicose veins these valves are liable to be destroyed. It is a curious fact that in ordinary quadrupeds the veins which run up and down, so to speak, or lie vertically, possess valves. On the other hand, veins which lie in a horizontal direction do not possess these structures. In the trunk or body of man, however, valves occur in the horizontal veins and are absent from those which are vertical, so that we are face to face here with an apparent human deficiency, seeing that those of our veins which ought to possess valves want them. The explanation of this anomaly would appear to consist in the idea of evolutionists that man is descended from a quadruped ancestor. When he assumed an upright position the structure of the veins remained unchanged, but those veins formerly vertical became horizontal, retaining their now useless valves, whilst those formerly horizontal becoming vertical remained destitute of valves. In the arms and legs the veins which are vertical both in the quadruped and man retained their valves. In the veins of the rectum or lower part of the bowel no valves exist, yet the presence of such valves would no doubt have had a very considerable effect in preventing the formation of hæmorrhoids or piles.

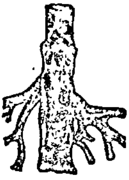


FIG. 51*a*.—A Vein opened, showing its pocket-like valves.

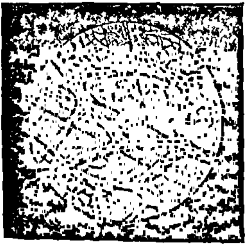


FIG. 52.—A network of Capillaries, showing a small Vein below them.

The Capillaries.—The capillaries (Fig. 52) have already been described as the finest blood-vessels of the body, forming a dense network in all parts of the frame as the result of the ultimate branching out of the arteries. The finest capillaries exhibit a diameter varying from the $\frac{1}{2000}$th to the $\frac{1}{3000}$th of an inch. They are, therefore, of such diameter that only one row of blood corpuscles can

pass along them at one time. The finest capillaries practically consist of tubes lined by cells of flattened character, united by their edges. Each cell contains a *nucleus*, or central particle. It can readily be understood that through the extremely thin walls of these capillary vessels the blood-fluid can readily strain in order to reach the tissues outside for their due nourishment. In certain parts of the body the capillary network is extremely dense. The brain and the lungs exhibit examples of such complicated networks. If we have regard to the enormous area which is represented by the capillaries, we find that their capacity amounts to about 500 times that of the arteries of the body. We have also to consider that, as regards the flow of blood, the force with which that fluid is propelled from the heart is gradually lessened as the stream passes from the smaller branches of arteries and is finally diffused through the network of capillaries, on the principle of the main stream of a river which may rush along with a fair amount of force, gradually losing its speed and momentum as it spreads over flat ground into many smaller channels. It is calculated that in the arteries the blood flows at the rate of about one foot per second. In the capillaries the rate is stated at about an inch per minute, and in the veins at about an inch per second.

The Pulse.—The subject of the pulse has already been considered (vol. i.) with reference to its significance as a sign or symptom of disease. It is necessary, however, here to refer to the pulse from a physiological point of view. When the heart sends blood out into an artery, the vessel naturally fills with blood. Immediately, however, the next stroke of the heart sends an additional amount of blood into the vessel the artery, through its elasticity, expands to receive the fluid, but in the interval before the next stroke of the heart, the artery itself contracts, its walls pressing on the blood contained within it, and thus forcing the fluid onwards. Putting these facts in another way, we may see that the work of the heart consists so far in forcing blood into the artery, and, second, in causing the artery to expand so as to receive the fluid. If we suppose this action to take place close to the heart, any recoil of the blood is prevented by the valves of the heart. The elasticity and contraction of the artery now come into play, and drive the blood forward. If we place our finger upon an artery, we find its contraction in the form of the "pulse," which naturally succeeds the beat of the heart. The pulse may therefore be regarded as the result of the expansion of the blood-vessel by the wave of blood sent from the heart, and of what may be called the recoil of its walls in virtue of their elastic nature. If the arteries were rigid tubes, no such pulsation could naturally be felt,

but if to a pump or syringe an elastic tube were attached, and water made to pass through the tube after the fashion of blood propelled from the heart, we should find the tube to exhibit movements comparable in one sense to those which constitute the pulse. No pulse exists in veins or in the capillaries, because by the time the blood has reached these vessels the force of the stream has been materially lessened. Physiologists have always recognised that whilst in large arteries *elasticity* forms their main feature, in the smaller arteries *contractility*, or the power of contraction, stands forth as their leading characteristic. It is through the influence of the nervous system, exerted through the fine nerves supplying the walls of the blood-vessels, that the quantity of blood permitted to flow through the system is regulated. This nervous action specially controls the muscular elements in the walls of the vessel.

It has already been remarked that whilst the flow in the arteries is, so to speak, of a jerky or intermittent character, that of the capillaries and of the veins is practically continuous. When the blood arrives at the capillaries (Fig. 52), it experiences a certain amount of resistance, so that whilst the heart and arteries are occupied in sending blood onwards, it is clear that the flow in the capillaries must necessarily be relatively slow. This result is brought about for the purpose of giving time and opportunity for the fluid of the blood to pass from the capillaries and to nourish the tissues, the main stream passing onwards to find itself sooner or later in the veins.

Circulation in the Veins.—In the veins (Figs. 49 and 50), as has been said, the flow of blood is also continuous, no pulse being perceptible. As the blood in the veins is passing towards the heart, it might naturally be asked how its onward flow is regulated, seeing that no propulsive force can be exerted from the body. There can be little doubt, however, that the flow in the veins—*upwards* from parts below the heart—is first of all aided by the continuous outward flow from the heart and arteries. In the second place, the presence of valves in the veins (Fig. 51) tending to prevent any backflow, will materially assist the progress of the current. A third agency in assisting the return of blood in the veins is that represented by muscular movements. In the course of such movements the veins tend to be pressed upon, and in this way the blood prevented by the valves from returning is forced onwards. Yet another cause of the return of the blood in the venous system is that attributed to the action of the lungs in breathing. The act of inspiration or "breathing in" is believed to exert a suction action, especially on the large veins in the neighbourhood of the heart, just as the expansion of the right side of the heart itself after its contraction may favour the emptying

of the big veins into the heart. With regard to the rapidity of the circulation to which reference has already been made, it has been experimentally calculated that in the case of the horse a given portion of blood will make the whole round of the circulation in that animal in about half a minute. This experiment was carried out by injecting into a vein of the neck a certain chemical substance which, conveyed the round of the circulation, appeared in the time mentioned in a similar vein on the opposite side.

The Nervous Control of the Circulation.—It has already been shown that the circulation of the blood in so far as the blood-vessels are concerned, and as will be shown also as regards the heart itself, is distinctly under the control of the nervous system. To the walls of blood-vessels very fine nerves are distributed. These are known as *vasomotor* nerves. They proceed from a controlling centre situated at the top of the spinal cord in that portion of the brain known as the *medulla oblongata*. This centre might be described as a kind of nervous sub-office, which exercises a perpetual control over the circulation of the blood. Each blood-vessel is thus maintained as regards the state of its walls in one of moderate contraction, that is to say, it is neither unduly expanded nor unduly contracted. If to the blood-vessels there passes through these *vasomotor* nerves some message or other calculated to stimulate them, the result is that the walls of the blood-vessels contract and less blood is sent through them. On the other hand, if the nervous agency keeping the vessels in tone is lessened, the blood-vessels tend to dilate or expand, so that a greater blood-supply is sent into them. These actions may either be of a transitory and passing nature, or may contrariwise exhibit a certain limited permanence. When we blush, an action is noted in which the ordinary state of the blood-vessels is exchanged for one of expansion, more blood is sent into them, and the skin reddens. Conversely, in the case of a person who faints or suffers from "shock," we find the opposite result brought about. Extreme contraction of the blood-vessels is for a time produced, limiting the blood-supply, and in this way causing pallor of the face and skin at large.

THE STRUCTURE AND FUNCTIONS OF THE HEART

If we inspect the heart of a bullock, which, save for its size and an excess of fat, resembles that of man, we find its substance to consist of muscular tissue. Any heart ranging from that of an insect to that of man may be described therefore as a *hollow muscle*.

The heart is hollow to allow blood to enter it, and it is a muscle that it may contract to expel the blood from it in certain directions. We thus find that the circulation of the blood is duly carried on by muscular action, the heart acting thus as a pumping-engine. The form of energy, in other words, through whose operation we are enabled to move our limbs in walking, our lips in speaking, or our hands in grasping, is that which in another aspect of its work distributes the blood through the system.

The Heart Muscle.—In dealing with the general muscular system of the body (vol. i.) it was shown that two sets of muscles exist in the frame. One set includes those muscles we name *voluntary* or *striped* in nature. The other set includes those which are *involuntary* or *unstriped*. The former muscles are those under the command of the will; the latter are those which operate independently of the will. The heart belongs to the latter class of muscle, in that, as is well known, it carries on its work outside the rule of our voluntary nervous system, although at the same time it is liable to be more or less affected by what we may term the moods and tenses of our nervous apparatus. It is also to be noted that the heart itself is definitely governed in its movements, as we shall see by a certain portion of the nervous system set apart for its control. Involuntary muscles are of "unstriped" character. That is to say, when their fibres are inspected under the microscope, they are seen to be made up of elongated cells, and are unstriped, whereas in the case of voluntary muscles the fibres present a striped appearance. The heart is, however, an exception to this rule, for while it is an involuntary muscle, its fibres are found to be constructed on the striped type. They, however, differ from the fibres of the ordinary muscles of the body in that they have no sheath, whilst they also branch (Fig. 53) and are connected with one another. The fibres of the heart in fact are formed of quadrate or somewhat square shaped cells each possessing a large nucleus or central particle of oval shape. By some authorities the structure of the heart muscle is regarded as indicating that it may be considered to form a connecting link between the involuntary and voluntary muscles in respect that probably the heart is more directly affected by the nervous system at large than are the other involuntary muscles of the body.

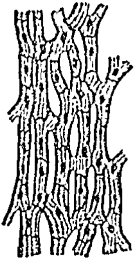


Fig. 53.—Muscular Fibres of Heart, largely magnified.

Position of the Heart.—The heart is situated in the cavity of the *thorax* or *chest*. It lies between the lungs and is partially covered by them. In respect of its shape the heart might be described as somewhat conical, the base of the cone lying upwards and being directed backwards, whilst the apex or point of the cone lies downwards and forwards. As most persons know, the heart lies largely on the left side. It is situated obliquely in the chest, and as regards its exact position it may be said, taking the breastbone as a kind of centre, that it passes beyond this bone to the extent of one inch on the right side and 2½ inches on the left. Anatomists are accustomed to map out the position of the heart on the chest wall in a manner readily understood. A line is drawn across the chest to correspond with the upper border of the cartilage of the third rib; that is to say, of the cartilage joining that rib with the breastbone. A second line is drawn at the point where the cartilage at the end of the sternum or breastbone is joined to the bone. Between these two lines the healthy heart may be said to exist. A vertical line is next drawn passing one inch over the right side of the breastbone, a corresponding line being drawn so as to pass 2½ inches to the left side of the breastbone. Between the limits of these lines the space occupied by the heart is duly indicated. The point of the heart beats against the wall of the chest on the left side in the space between the fifth and the sixth ribs. It is smaller in woman than in man. Its average weight is about eleven ounces in the male and nine ounces in the female. As regards its dimensions, an average estimate would be 5 inches long, 2½ inches thick, and about 3¼ or 3½ inches broad. A rough mode of estimating the size of the heart is that of comparing it to the clenched fist of the individual.

The Heart Sac.—We find the heart to be retained in its place by the large blood-vessels which enter and leave it. These are found at the top or base of the heart. The organ itself is enclosed in a double bag called the *pericardium* or "heart sac." The inner layer of the pericardium covers the surface of the heart. The outer layer is that which we should popularly term the heart sac itself. Between these two layers a fluid is secreted known as the *pericardial fluid* this fluid serving to lubricate the movements of the organ. When this fluid increases abnormally in quantity in disease that affection is popularly spoken of as "dropsy of the heart." The heart bag is found to pass upwards so as to cover the roots of the large blood-vessels at the base of the heart, the two layers of the bag joining at this point. By its lower end the pericardium is joined to the upper surface of the diaphragm or great muscle which completely separates the chest from the abdomen or belly below. This muscle is the chief

agent in inspiration. The heart substance, it need hardly be said, is duly supplied with blood-vessels, absorbent vessels and nerves. With respect to the arrangements of the mechanism of the fibres of the heart it would appear that these, according to the researches of Pettigrew and others, are disposed in a series of spirals, a structure which greatly facilitates the particular work they are called upon to perform.

The Build of the Heart.—In order to gain a popular, but at the same time adequate idea of the exact build of the heart, it is only necessary to compare it to two semi-detached villas. If we have regard to the conditions of life in two houses of this description, we note that there can be no communication between them through the partition or common wall which separates them. If it is desired to pass from one house to the other, that may be accomplished either by passing out of the one front door and in by the other, or making use of any similar communication which may exist at the back. The heart regarded from this point of view may therefore be seen to be divided completely into two distinct sides, between which there is no direct communication in the adult. Whilst we speak of the two sides of the heart, denominating them *right* and *left*, we might almost as legitimately speak of a "right heart" and a "left heart," seeing that the functions of the one side of the heart are entirely different from those performed by the other. All quadrupeds, and likewise all birds, agree with man in the possession of such a heart, whereas reptiles and frog-like animals possess a heart of different build, in which the characteristically two-sided structure is wanting. Almost all fishes on the other hand possess an extremely simple heart, which corresponds to one side (the right side) of man's organ. The meaning of this double heart arrangement is easily perceived when we reflect upon the really double character of the circulation it performs. In the first place the heart has to distribute *pure* or *arterial blood* throughout the body. In the second place it has to send the *impure* or *venous blood* to the lungs. It is the left side which performs the former function, the right discharging the latter duty. Hence the left side of the heart is often called the *systemic* side, the right being termed the *pulmonary* or lung side. The importance of the complete division of the heart into two sides can now be estimated, seeing that it is only possible in this way to avoid any admixture of the pure blood passing from the left side with the impure blood in the right side, which, as we have seen, is being sent to the lungs for purification. Before birth it may be mentioned a communication exists between the right and the left side. This communication has reference to the peculiarities of the circulation in early life. The opening closes soon after birth, and no

interchange of blood between the two sides of the heart is therefore, in the healthy body, possible afterwards.

When the outside surface of the heart is inspected a groove is seen to run round its base, whilst another groove passes in an oblique fashion downwards from the base towards its apex or point, this groove existing on both front and hinder surfaces. These grooves roughly divide the heart into the four chambers or compartments which mark its interior. The groove at the base is known as the *auriculo-ventricular groove.* Here we find situated the blood-vessels and nerves which supply the heart walls with blood. The other oblique groove is called the *inter-ventricular groove.* It also contains vessels and nerves. The four cavities of the heart consist of two *auricles* and two *ventricles*, the former so-called because each of them possesses a little ear-like process at its upper part. These cavities are spoken of as the right auricle and right ventricle, and the left auricle and left ventricle respectively. Each side of the heart thus consists of an auricle above, which opens into its corresponding ventricle below. The partition already spoken of between the two sides of the heart separates the auricle and ventricle of the one side from these cavities on the other side.

Auricles and Ventricles.—The auricle is the receiving compartment of each side. It may be described as practically a reception chamber for the blood, the ventricle being the pumping or propelling chamber. The walls of the auricle are thin and of soft consistence, and in this respect contrast forcibly with the walls of the ventricles, which are extremely strong and muscular. As the left ventricle, however, has by far the greater share of the heart's work to perform, in that it has to pump blood through the whole system, whilst the right ventricle has only to transmit it to the lungs, we find the left ventricle to exhibit an extreme thickness as compared with the right. Each of these four cavities of the heart is lined with a membrane of serous character called the *endocardium*, whilst a development of this same lining forms the beautiful valves found in the heart's interior, these latter structures being intended to direct the blood in its proper course. The nourishment of the heart, it may be mentioned, is chiefly carried out by the *coronary arteries* (Fig. 55), which are given off from the arch of the *aorta*, or main artery (1) arising from the left ventricle itself. The blood is returned from the heart by corresponding vessels known as the *coronary veins.*

The Course of the Circulation.—Before proceeding to note the exact manner in which the heart discharges its functions, we must endeavour to gain an idea of the exact course pursued by the blood in its circulation. Commencing with the pure or arterial blood

coming from the lungs, we find this to be conveyed by the *pulmonary veins* (Fig. 54, *b*) coming from each lung, which carry the blood to the left auricle. These vessels are called "veins," although they carry pure blood, because they return blood *to* the heart. From the left auricle (*c*) the blood is sent into the left ventricle (*f*), and by this latter cavity it is propelled all through the body. Passing into the capillaries it nourishes the body (*h*), as has already been described, and from the capillaries continues its course into the veins (*k*). Gathered up by these latter vessels it is conveyed to the right auricle (*d*) of the heart, so that the blood has now arrived at the right side of the heart, but has had to make the circuit of the body in order to reach this point. From the right auricle the blood passes into the right ventricle (*e*). This latter cavity propels it into the lungs, where, being purified and receiving a fresh supply of oxygen, it is converted into arterial blood, and, passing to the left auricle and left ventricle (*c*, *f*), is once more ready to begin the round of the circulation. The circulation from the left side of the heart through the body is sometimes called the *greater* or *systemic circulation*, that through the lungs being denominated the *lesser* or *pulmonary circulation*. It should be noted that each vessel which carries the blood from the right ventricle to the lungs is called a *pulmonary artery* (*a*). Here again we should have expected a reversal of terms, seeing that it carries impure blood, but it was so named, however, from the fact that it carries blood *from* the heart. The main artery which leaves the heart is called the *aorta* (*g* and Fig. 55, 1, 2). This vessel springs directly from the left ventricle. For a further description of the general distribution of the arteries in the body the reader may be referred to the section of this work dealing with ambulance, or first-aid. In the portion of that section devoted to the treatment of hæmorrhage (or bleeding) a general idea is given of the arterial system.

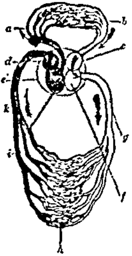


FIG 54.—Plan of the Circulation. *The arrows* indicate the direction of the bloodflow from the Lungs by the Pulmonary Veins (*b*) to (*c*) the left Auricle, and (*f*) the left Ventricle of Heart, through the Aorta (*g*) to the body (*h*); from the body by the veins (*k*) to (*d*) the right Auricle, thence to right Ventricle (*e*), and thence by (*a*) the Pulmonary Arteries, back to the Lungs.

The Mechanism of the Heart.—Viewing the heart as a pumping-engine, it is obvious that we must take into account the particular mechanism through which the blood is duly directed in its proper course. The chief interest regarding this portion of the subject centres, first, around the *valves of the heart;* and, second, around

the subject of its *nervous regulation and control.* We might popularly define a "valve" of any kind as a structure intended for the purpose of regulating the flow of fluids or gases in their proper directions. In the case of the valve of an ordinary pump we know its function to be that of preventing the return to the well of water which has just been drawn from it. Indeed, the functions of most valves may be regarded as summed up in the expression that they are necessary to prevent what may be termed "back flow" or *regurgitation.* Two sets of valves exist on each side of the heart, the one set being practically a duplicate of the other. When the interior of the heart is examined and the auricle opened, we find the right auricle receiving the venous blood from the body by means of two large vessels known as the *venæ cavæ;* one of these, the superior, returning blood from the upper parts of the body, the other, the inferior, returning the blood from the lower parts. In the little ear-like arrangement of the auricle we find a raised appearance of its lining membrane and muscular substance resembling the teeth of a comb. To this structure the name of *musculi pectinati* has been given. The inside of the ventricle shows on its wall a large number of projections. These consist of the muscular substance of the heart and are covered by the lining membrane. To these projections the name of *columneæ carneæ* are given. Other projections from the wall of the ventricle are known as *musculi papillares*, or in other words "papillary muscles." The difference between these two series of projections rising from the inner wall of the ventricles is found in the fact that whilst the *columneæ carneæ* exhibit free ends the *musculi papillares* have attached to them certain delicate cords called *chordæ tendineæ* (Fig. 56). These cords are in turn attached to the flaps of certain valves to be presently described.

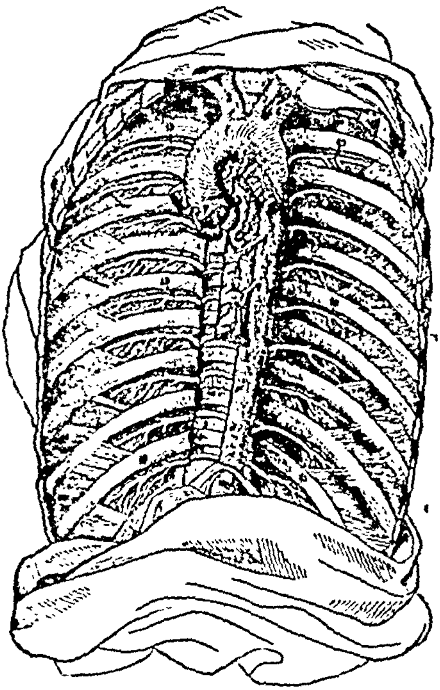
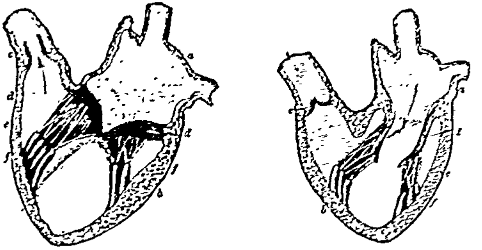


FIG. 55.—Blood-vessels of Chest, &c.

1, Arch of Aorta; 2, Thoracic part of Aorta; 3, Branch to Head; 4, Subclavian Artery (left); 5, Left Common Carotid Artery; 6, Valves at entrance to Aorta; 7, 7, Coronary Arteries of Heart; 8, 8, Arteries of Lungs; 9, 9, 9, Arteries of Gullet; 10, 10, 10, Intercostal Arteries.

The Valves of the Heart.—Between the auricle and ventricle of each side we find a valve dividing the one cavity from the other. On the left side the valve is known as the *bicuspid* (composed of two cusps or flaps) or *mitral valve* (Fig. 56, A), the latter term being derived from the resemblance of its flaps in shape to the mitre of the bishop. The corresponding valve between the right auricle and right ventricle is called the *tricuspid valve*, because it consists of three flaps. These valves may be popularly termed "flap valves" of the heart, seeing that they consist of flaps or folds. The remaining valves of the heart are known as *semilunar valves* (Fig. 56, c), this term being applied to them in reference to their somewhat half-moon shape. These latter



A B

FIG. 56.—The Heart (left side), showing (in A) the Valve (d d) between Auricle (a) and Ventricle (b), shut; in B open. At c the Semilunar Valves are shown open in A and shut in B; d d are the Flaps of the Valve between Auricle and Ventricle; e e are the Cords; and f f the attachment of the Cords to the Ventricle wall. The arrow indicates the course of the blood.

valves are of different nature to those just mentioned. A semilunar valve consists of three pockets placed in a circle in the left ventricle, at the entrance of the aorta or great main artery carrying blood to the body. The other semilunar valve of a similar nature in the right ventricle exists at the entrance to the pulmonary artery which, as we have seen, conveys impure blood to the lungs.

How the Valves Act.—The functions of these valves can now be readily understood. When each auricle contracts it sends the blood downwards into the ventricle. The succeeding contraction of each ventricle propels the blood to the body and the lungs respectively. If no valve existed between the auricle and ventricle, the blood would tend on the contraction of the latter to regurgitate, or in plain language to go back the way it had come. The functions of the

valves between the auricles and ventricles are therefore seen to be those devoted to the prevention of any backflow into the auricle. Again, when the ventricles contract, the blood is forced out of the body and lungs respectively. As the blood-vessels receiving the blood contract, a backflow might occur into the ventricle, hence the semilunar valves (Fig. 56, *c*) prevent this latter result.

In order to understand the manner in which the flap valves—that is, the "bicuspid" and "tricuspid" valves—act, it is necessary to remind ourselves that each of these valves consists of flaps or folds (Figs. 56, 57) of a somewhat triangular shape, fixed by their bases round the entrance into the ventricle, and connected to the projections of the wall of the ventricle already described by the cords. When blood passes from the auricle into the ventricle, the flaps press against the walls of the ventricle and allow it free ingress into that

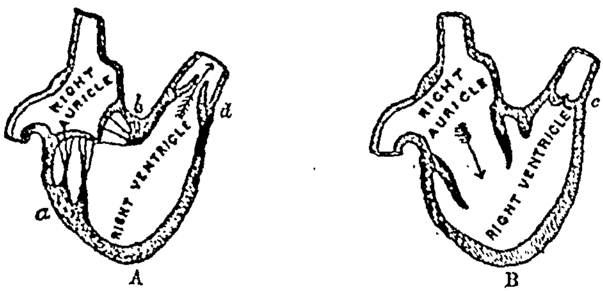


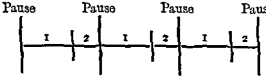
FIG. 57.—The Valves of the Heart.
In A the Valves between the Auricle and Ventricle are closed, in B open. Note the Valves in the Blood-vessels open in A (*d*) and shut in B (*c*); *a b* show the attachments of the Flaps of the Valves.

cavity (B). As, however, the blood fills the cavity, the flaps are forced up by the fluid, so that the flaps meet accurately together, and the opening between the auricle and ventricle is thus closed (A). The functions of the tendinous cords and the muscular projections of the wall of the ventricle can now be understood. As the blood is attempting to force its way backwards into the auricle, the flaps are held in position by the cords, which are pulled on by the papillary muscles. A temporary but complete partition is thus formed between the auricle and ventricle (Fig. 57, A), and all risk of the flaps being floated upwards is avoided. When the ventricle has cleared itself of blood, the flaps once more assume the vertical position (B), and are pressed close to the sides of the ventricle by the next inflow from the auricle. Each semilunar valve (Fig. 58), to revert to the second set of these organs, consists of three pockets placed in a circle at the entrance to the great blood-vessels leaving this ventricle. The mouths of these pockets *open away from the ventricle.* When the

latter cavity forces blood into the vessel, the fluid stream easily rushes past the mouths of the pockets (*d*). If, however, any backflow took place, this would have the effect of filling the pockets, and of therefore causing their edges to approximate closely together, in which case again, an effective barrier is formed to any regurgitation of the blood into the ventricle (*c*).

The Heart's Action.—With reference to the action of the heart, it is found that whilst the two auricles contract together, the two ventricles also simultaneously contract, the contraction of the one following the contraction of the other. When the ventricles are contracted to send blood out of the heart, the auricles are again expanding in order to permit of a fresh inflow of blood from body and lungs. Each ventricle expands in like manner after contraction so as to receive a fresh inflow when each auricle contracts.

The Heart Sounds.—If we listen to the *sounds* of the heart, we note that they are of a double character, and therefore that they, so to speak, go in pairs. The first sound is long and loud, the second sound short and sharp. Between the first and second sound a short pause takes place, a longer pause existing between the second sound and the next first sound, this longer pause indicating the interval between the pairs of sounds. A knowledge of the nature of these sounds is important from the point of view of the physician. The first sound is believed to be caused by the contraction of the ventricles and also by the closure of the flap valves. Yet another cause of the first sound is believed to consist in the contact of the heart with the chest walls. There is no doubt about the cause of the second sound. This is produced by the closing of the semilunar valves. When the valves of the heart are in any way disordered, the natural sounds are more or less altered.



The above diagram represents the succession of the sounds of the heart, the vertical lines representing the pauses and the straight lines the sounds, while the figures refer to the first and second sounds. The sounds of the heart, as heard by pressing the ear against the wall of the chest, may be accurately enough imitated by the word "lŭbb" representing the first sound, and the word "dŭp" as representing the second. The contraction of the heart's cavities is called *systole*, and their expansion *diastole*. The heart may be regarded as a rhythmic muscle, that is to say a muscle which has

been tuned by nature to perform its work in a regular and given manner. If we consider that a beat of the heart may be represented by a cycle divided into tenths, the first sound is estimated by physiologists to occupy four-tenths of the cycle, and the second sound two-tenths. The first pause, that is between the two sounds, would occupy the one-tenth, and the second or longer pause three-tenths. Another mode of calculating the work of the heart gives one-fifth part of a second as the time represented by the contraction of the auricle, two-fifths by the contraction of the ventricles, the resting period of the heart represented by the pause being calculated at two-fifths. The beating of the heart is modified by conditions represented by age, sex, exercise, food, and other details of life. It beats much more quickly in early life, for at birth we find the rate to be about 140 per minute. It slows down gradually through youth, until in the healthy adult the beats vary from 65 to 75, a greater rapidity being found in women than in men. The recumbent posture, as in sleep, slows the beating of the heart, and a vast amount of work is saved during the hours devoted to rest. It is stated that in twenty-four hours of absolute rest in bed, the beats of the heart are decreased to the extent of over 17,000.

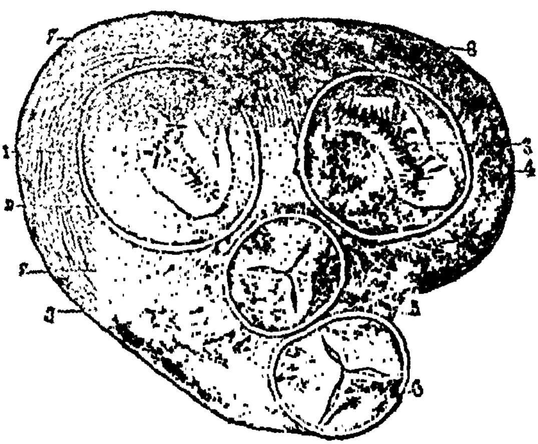


Fig. 58.—The Base of the Heart dissected (from above).
1, Right Ventricle, showing the three Flaps of Tricuspid Valve; 2, the Ring of the Valve; 3, the Left Ventricle and the two Flaps of the Mitral Valve; 4, Ring of Valve; 5, Aorta and its three Semilunar Valves; 6, Pulmonary Artery and its Valves; 7, 8, and 9, Muscular Layers of Heart.

The Heart's Work and Rest.—The work of the heart or of the body at large is estimated by the *foot pound* or *foot ton.* The unit of work here is represented by the amount of energy or power required to raise one pound or one ton respectively one foot high. Calculated on this basis, the work of a man's heart in twenty-four hours, summed up, as it were, into one big lift, would be capable of raising 300,000 lbs. one foot high, or that capable of raising a man's weight (150 lbs.) 2000 feet. Another calculation gives us 120 tons as the twenty-four hours' work of the heart; that is, a force capable of lifting 120 tons weight one foot high. From what has been said regarding the nature of the heart beats and the pauses which

occur between them, it may be said that the heart practically rests as much as it works. If we consider that the sounds represent the work of the heart, the intervals between them represent periods of rest. The heart is therefore in the position of a workman accustomed to take short periods of repose between spells of work. An ordinary physiological calculation is to the effect that the heart practically works for three-fifths of each cycle, and rests the remaining two-fifths.

Nervous Control of the Heart.—The heart has already been shown to be controlled and governed by the nervous system. A special nervous mechanism is set apart for the purpose of governing its movements. Two nervous systems exist in the human body. One of these we may call the *brain system*, the chief parts of which consist of the brain and spinal cord (Fig. 59, *B*). The other system lying in front of the spine is known as the *sympathetic system* (*S*), this latter system being devoted to the regulation of parts lying outside the command of the will. Embodied in the substance of the heart we find a mass of nerve cells known as *cardiac ganglia* (*CG*).

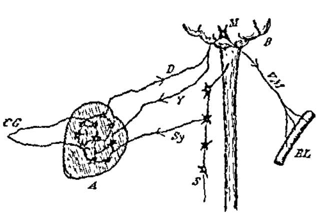


FIG 59.—Diagram of Nervous Regulation of Heart.

These represent a small portion of the sympathetic nervous system *detached as it were for the "home rule" of the heart.* These ganglia are practically responsible for the control of the heart's ordinary work; in other words, they exist for the purpose of stimulating its muscular fibres to contract in the discharge of its ordinary duties. A difference is generally recognised between these nervous centres of the heart itself. The vast majority are engaged in stimulating the movements of the heart, but one or more is devoted to what may be called the *inhibition* or restraint of the heart's action. Passing into the heart we find the branch of a large nerve coming from the brain system, and known as the *pneumogastric* or *vagus* (*V*). This nerve has the function of slowing the heart's action, probably by reason of its connection with those centres of the heart itself already mentioned as tending to inhibit its movements. A second nerve

proceeding from the sympathetic system also enters the heart (*Sy*), and is connected with those ganglia which are the cause of its ordinary contractions. It is the duty of this sympathetic nerve to stimulate or quicken the heart's action. If the heart be compared to a horse which is quietly being driven along the road we might assume that the *cardiac ganglia* represent the source of the ordinary quiet and unrestrained action of the animal; whilst on the other hand the *vagus* nerve would represent the bit which checks its excessive speed, and the *sympathetic* nerve the spur or the whip which excites it to quicker movement.

The Depressor Nerve.—Another nerve connected with the heart deserves attention by way of conclusion. This is known as the *depressor nerve* (*D*), whilst it may also be spoken of popularly as the "relief nerve" of the heart. It brings the heart intimately into connection with the blood-vessels. Its action is of a highly interesting character. It is brought into operation when for some reason or other the heart's action is much impeded, and when the heart shows a tendency to become exhausted over the increased work which it is called upon to perform. In such a case a nervous message or impression is transmitted along the *depressor nerve* to the *vasomotor centre* (*M*) in the brain, the centre already mentioned when dealing with the regulation of the blood-vessels. The effect of this message is to restrain or inhibit the action of this centre, when, as has been already explained, the tone of the blood-vessels (*BL*) relaxes and as a consequence they dilate or expand. As it is easier for the heart to propel blood through wide and expanded channels than through narrow and contracted ones, the heart's work is in this way relieved, and any danger of collapse under ordinary circumstances avoided. The action of the depressor nerve forms an excellent example of one of those wonderful self-regulating and preservative actions so commonly met with in the study of the physiology and control of our frames.

SECTION III

DISEASES OF THE HEART AND BLOOD

Palpitation.—Under ordinary circumstances we are unconscious of the beating of our hearts, but whenever the beats become *perceptible* to the individual, he is said to suffer from "palpitation." This is what is termed a *functional* disorder of the heart; that is to say, no diseased condition of the heart is discoverable. Of course palpitation may be an accompaniment of serious organic changes in the heart, but at present only those cases are under consideration in which no such condition is present. A person suffering from palpitation usually complains of an irregular or forcible beating of his heart; there are as a rule, in addition, feelings of faintness, of difficulty of breathing, and sometimes a sense of impending death, though actual pain is seldom complained of. Palpitation may be the result of fright, or of over-exertion. It is common amongst hysterical women, and in those suffering from neurasthenia. In the disease called *goitre* it is a persistent symptom. Over-indulgence in alcohol, tea, coffee, and tobacco frequently produce it. Over-eating, and the presence of undigested particles of food in the stomach, or of flatulent distension of that organ, are common causes. So also are all practices which lower the tone of the nervous system. It is sometimes due to derangement of other organs, more especially of the uterus and ovaries. In addition to palpitation, there are other alterations in the *rhythm* of the heart's beat which may be mentioned. Thus the pulse is said to be *intermittent* when one or more beats are dropped; *irregular*, when the beats follow each other at irregular intervals, and are unequal in volume. Sometimes two or three beats follow in rapid succession, and these are divided from the next group by a longer interval. Such is known as the *bigeminal* or *trigeminal* pulse; or again, the beats are more frequent, but less full, during inspiration than during expiration. This form is sometimes noticed in sleeping children, and is known as the *pulsus paradoxus;* and lastly, the pulse may take on what is known as the *gallop* rhythm, where the heart-sounds resemble the sounds produced by a cantering horse. These alterations in rhythm may be due to diseased conditions of the heart itself, or to disease in the brain or other organs; but they are frequently also produced by poisoning from over-indulgence in tobacco, tea, and coffee In the *treatment* of palpitation and the allied nervous

affections of the heart, an attempt must in the first instance be made to allay the patient's fears, as the mind has a marked effect on the heart. Then, if organic disease of that organ can be eliminated, an endeavour must be made to discover the existing cause, and to remove it; and herein lies the difficulty. The patient should keep regular hours, avoid large meals, and rest in the recumbent position for a considerable part of the day. Alcohol, tobacco, tea, and coffee should be absolutely prohibited, and all food that causes *flatulent distension* avoided. If the patient is bloodless he should have iron in some form. To allay the general irritability, bromide of potassium, in 10-grain doses, three times a day, may be given. It becomes necessary sometimes to give digitalis, but nux vomica often does better, and may be given as in the following prescription: Tincture of nux vomica, 4 drachms; spirits of chloroform, 1½ drachms; aromatic spirit of ammonia, 3 drachms, and compound infusion of gentian, up to 4 ounces. A dessert-spoonful of this mixture to be given in water three times a day.

Angina Pectoris.—*Pain* in some form or other is a frequent symptom in affections of the heart, both functional and organic, and is known as *cardialgia*; it is most often situated on the outer side of the *left nipple*. It is sharp, cutting, or boring in character, and often shoots across the left arm. It is increased by exertion or palpitation, and often comes in paroxysms. The excessive use of tobacco, tea, and coffee may cause palpitation and rapid action of the heart, as has been already pointed out; but it may also give rise to *pain*, sometimes of a very severe character.

Apart from these pains, however, which are as a rule bearable, there is a severe form of heart pain called *angina pectoris*, and commonly known as *breast pang*, which occurs suddenly, and is accompanied by a sense of *approaching death*. The first of such attacks is always absolutely *sudden* in its onset, and generally comes on when the victim is exerting himself in some way, such as when walking up hill, or against a strong wind, or stopping to lace his boots. Frequently, too, the first attack comes on after the first meal of the day. The pain is most frequently situated behind the lower end of the *breastbone* inclining to the left side. It comes on, as has been said, with absolute suddenness, and is of so commanding a nature, that the patient has to desist from whatever act he may be occupied in. Its *character* is variously described as being boring, gnawing, as if the chest were held in a vice, as indescribable, and as being so intense, that its continuance or increase must, in the patient's opinion, end in death. From its starting-point, the pain spreads over the chest to the back, and shoots up to the head and down the

left arm. During the attack the pulse is feeble, the face pallid, the limbs cold, and the body covered with a clammy perspiration. Such an attack may last for a few seconds and then pass away, not to return again for some considerable time, or there may be a recurrence of the attacks for an hour or so. Some patients have several attacks during their lifetime, others, such as Arnold of Rugby, have only one, which terminates fatally. The *cause* of angina pectoris is obscure. By some it is looked upon as a *neuralgia* of the heart; others think it is due to *spasm* of the heart muscle, or of the minute muscles in the walls of the small blood-vessels, whilst others again think it is due to a deficient blood-supply to the heart itself, and this view is borne out by the fact, that in nearly every case the *coronary arteries*, which supply blood to the walls of the heart, are diseased. The *treatment* of angina consists in leading a quiet life and avoiding stimulants—tea, coffee, and tobacco. When an attack comes on, three to five drops of *nitrite of amyl* should be inhaled. This drug may be obtained put up in small glass capsules, some of which should always be carried about by the patient. In case of attack the patient breaks a capsule in his handkerchief and inhales the vapour. If the nitrite of amyl fails, *chloroform* should be inhaled, as nothing relieves the pain more quickly. This drug should of course be administered by a medical man. Hypodermic injections of morphia also relieve the pain, and sometimes when the attack has been very severe, it is well to give the chloroform first, and then to inject the morphia before the effects of the former drug have passed off.

During the interval between attacks, *one drop* of a one per cent. solution of nitroglycerine should be taken three times a day, as it frequently prolongs these intervals.

Pericarditis.—The *pericardium* is the membranous sac which encloses the heart as in a bag. Its surface is very smooth, and it contains a little fluid which allows the heart to move freely. It plays the same part towards the heart that the *pleura* does to the lungs. Inflammation of the pericardium or pericarditis very rarely begins as an independent disease, though it very frequently arises as a *complication* in the course of certain general diseases. It may be the result of *wounds* in the neighbourhood of the heart, or the inflammation may spread to the pericardium from adjacent organs. Thus pericarditis frequently occurs in *pneumonia*. It most frequently occurs as a complication of *rheumatic fever*; indeed, sometimes the *joint* symptoms are scarcely noticeable, whilst those of the pericardium are very marked. *Quinsy* or acute tonsillitis occurring in people with a rheumatic tendency, is frequently complicated with pericarditis; it is also present along with *chorea* or St. Vitus's dance, which is a disease

allied to rheumatic fever. The disease is apt to appear during the course of some of the acute infective fevers, more especially *scarlet fever*. It is often *tubercular* in its origin, more especially amongst children, and lastly *gouty* people and those suffering from *chronic Bright's disease* are prone to attacks. As in the pleura, we have a *dry* form of pleurisy, and one accompanied by *effusion*. So in the pericardium, there may be a dry inflammation, or one accompanied by the effusion of serum or pus or even blood, and if the case terminates favourably, the pericardium may resume an absolutely normal condition, or it may adhere to the surface of the heart, and so lead to a permanent change. Dry pericarditis is in itself a comparatively harmless disorder, death from it being extremely rare, though many people die from the disease of which it is only a complication, and the *symptoms* it gives rise to may be nothing more than a slight rise in the temperature, and perhaps some *pain*. On listening over the heart with a *stethoscope*, however, a very characteristic friction sound is heard, which corresponds as to the time of its production with the contraction and dilatation of the ventricles, each time that this occurs the rough inflamed surface of the heart comes against, and is drawn away from the rough inflamed surface of the pericardium, and thus a *to-and-fro* friction sound is heard, which, once recognised, can never be mistaken for anything else. When pericarditis leads to effusion of fluid, the *symptoms* are more marked, though even here, in the case of children, they may be very insidious, so that nothing may be noticeable beyond some *shortness of breath* and slight *fever*, and this is particularly the case when the disease is of tubercular origin. As a rule, however, on the appearance of fluid the temperature rises, there is a severe *pain* of a stabbing nature situated at the lower end of the breastbone, and there is marked difficulty in breathing. If a large quantity of fluid has been poured out there is a bulging of the chest, especially in children. The sounds of the heart are muffled or altogether absent, and the *apex beat* is higher than it ought to be, or cannot be felt at all. The pulse is full and hard to begin with, but it soon becomes soft, rapid, and *irregular*. The act of swallowing is accompanied by pain, and the patient suffers from an irritating cough. In the later stages of the disease restlessness and want of sleep greatly distress the patient, and he may eventually lapse into a state of low and muttering delirium.

Treatment.—A patient who develops symptoms of pericarditis has probably already been put to bed on account of the general disease from which he, as a rule, has been suffering, but in the event of this not being the case, this should certainly be done as soon as the condition is discovered, as absolute bodily and mental rest are of

great importance. A few *leeches* applied over the heart area of the chest greatly relieve the pain and lessen the severity of the attack. With the same object in view, an *icebag* may be applied to the same region for half-an-hour at a time to begin with, and continuously when the patient becomes accustomed to it. When an effusion is present small *fly blisters* often cause a rapid absorption of the fluid, and a *saline purge*, such as Epsom salts, is also an efficient aid. Should these measures not be effectual, and the amount of fluid increase, the surgeon's aid must be called in, and, in the cases where the fluid consists of serum, an aspirator needle used to draw off the fluid; whereas should *pus* be present, the condition must be treated as one of *abscess* in any other locality, and a free *incision* made to give free egress to the matter.

Endocarditis.—Just as the membrane covering the *outer* surface of the heart, and the membranous bag in which that organ is contained, are subject to inflammation termed *pericarditis*, so the lining membrane of the *inner* surface of the heart and the folds into which it is thrown to form the *valves* at the orifices of the chambers are also the seat of inflammation, constituting the disease called *endocarditis*. The inflammatory changes, which are almost entirely confined to the *valves*, and more especially to those of the *left side* of the heart, consist in a roughening of the surface of the valve and of a deposit of *fibrin* from the blood on the roughened surfaces. This deposit gives rise to the formation on the valves of fringes of cauliflower-like growths or *vegetations* which greatly impair the utility of the valve. The inflammatory process may be arrested at this stage, and the affected valve completely recovers, but far more frequently the process becomes *chronic* and leads to structural changes in the tissues of the valve which cause deformity, and this may lead either to a *narrowing* of the orifice and, consequently, to *obstruction* to the flow of blood through it, or to a crumpling up of the valve which allows the blood to *regurgitate* or flow in a wrong direction. Finally, the inflammatory process, instead of becoming arrested at the stage of vegetation formation, may go on to that of *ulceration*, in which case portions of the valves are eaten away and fragments of vegetation are broken off and sent into the general circulation. These give rise to symptoms of general *blood-poisoning*, constituting what is termed malignant or acute ulcerative endocarditis.

Acute endocarditis occurs most frequently during the course of an attack of *acute rheumatism*; it is sometimes present along with rheumatic *tonsillitis*, and is also a complication of *scarlatina*. The ulcerative variety may occur as an independent disease, but very frequently occurs in combination with acute *pneumonia*. The

symptoms of acute endocarditis are not very marked. During the course of acute rheumatism the patient may complain of nothing pointing to the heart, and all that may be noticed is a slightly more rapid and *irregular* pulse. On listening over the heart, however, a *murmur* may be detected, more especially when the *mitral* valve is affected. The *chronic* form of the disease may be the result of an acute attack, or it may come on insidiously as a result of prolonged over-indulgence in *alcohol*, in people who suffer from gout or syphilis, and also in those who have to undergo prolonged *muscular exertion.* Not much can be done in the way of *treating* cases of acute affections of the valves of the heart. No known *drug* is of any avail either in curing or avoiding them, but prolonged *rest* after an attack of rheumatic fever affords the best hope of the damaged valve being restored to its normal condition, and to procure this for the *heart*, as well as for the whole system, the use of *alcohol* and *digitalis* should be avoided.

Chronic Valvular Disease.—To enable the reader to understand the condition which arises when one or other of the *valves* of the heart is affected, either as a result of acute endocarditis or of slow changes set up in it by the circulation in the system of poisons, such as those of gout, syphilis, or alcohol, it will be necessary to draw his attention to the *course* the blood takes through the heart, and to the part the valves play in its normal circulation. The heart is a hollow muscular organ, divided into a right and a left half. Each half of the heart consists of two chambers, an *auricle* and a *ventricle*, which communicate with each other by an opening termed the auriculo-ventricular opening, and each of these openings is guarded by flaps, termed valves, of the lining membrane of the heart, the free ends of the flaps being in the ventricles. As has been shown, the valve of the right side of the heart is called the *tricuspid* valve, because it has three flaps; that of the left side the *mitral*, because it somewhat resembles a bishop's mitre, having only two flaps. The blood flows from the systemic veins into the right auricle; from the right auricle it passes into the right ventricle, the tricuspid valve offering no obstruction to its passage, in health. Whenever the right ventricle is full of blood, it *contracts*, the flaps of the tricuspid valve are pressed together by the blood contained in the ventricle, and thus effectually *close* the auriculo-ventricular opening, and prevent a *regurgitation* of blood into the auricle; the *pulmonary artery*, however, is open, and the blood courses along this on its way to the *lungs*. As soon as the right ventricle begins to relax again to receive a fresh supply of blood from the auricle, the valves at the opening of the pulmonary artery—the free edges of which lie in the artery—are brought into play by the

column of blood contained in that vessel, and they close and prevent a regurgitation of blood into the ventricle. The same cycle of events is taking place at the same time on the *left* side of the heart; the blood from the lungs is brought by the pulmonary veins into the left auricle; it passes from thence into the left ventricle, and when the walls of this chamber contract, the *mitral* valve closes and prevents a regurgitation into the auricle, and the blood has perforce to pass into the *aorta*. So soon as the walls of the left ventricle relax, the valves guarding the aortic opening come into play, and prevent the blood falling back into the ventricle. The period during which the heart muscle is contracting is termed the *systole*, whilst that during which it is relaxed, the *diastole*; and it will be noted that during the systole the tricuspid and mitral valves are in action, whilst during the diastole the pulmonary and aortic valves are brought into play.

Now, as has already been remarked, the effect of endocarditis on the valves is either to cause a narrowing of the opening, resulting in what is termed *stenosis* of the valve, and leading to an *obstruction* to the flow of blood in its *natural* direction, or else to such a disorganisation of the valves as to no longer permit of their edges coming together, and effectually closing the opening which they guard, which allows a certain amount of blood to leak through and re-enter the chamber which it had left a second before—to *regurgitate*, in fact—and flow in an *unnatural* direction. These changes have a marked effect, first on the heart itself, and finally on the whole circulatory system. In the heart itself, whenever there is *stenosis* there is enlargement or *hypertrophy* of the walls of the chambers that lie behind the narrowing—thus, in stenosis of the mitral valve the left auricle hypertrophies; in stenosis of the aortic valves, the left ventricle hypertrophies. In *regurgitation* at the mitral orifice, the left auricle first dilates and then hypertrophies, and the same changes take place in the left ventricle when there is regurgitation at the aortic orifice. Further, these changes are not confined to the region of the heart lying immediately behind the seat of mischief, but the effects are passed *backwards* until the whole heart is involved. In stenosis of the mitral valve the left auricle hypertrophies, but in spite of this fact, the blood is dammed up to some extent in the *lungs*, and to overcome this the *right ventricle* has also to increase its powers and becomes hypertrophied. A further result of diseased valves is to produce altered *sounds* in the heart. Normally there are two sounds present, thus—lŭb-dŭp—the first sound being due, along with other causes, to the closing of the tricuspid and mitral valves, the second to closure of the aortic and pulmonary valves; but when one or other valve

is altered a new sound is produced, termed a *murmur*, and the time when this occurs will depend on the particular form of disorder, and on the valve affected. Thus, in stenosis of the mitral valve, if one places one's ear against the spot on the chest where the apex of the heart can be felt to beat, a blowing sound will be heard, which comes just before the first sound of the heart. If there is a *regurgitation* at the aortic orifice, due to *incompetence* of its valves, the second of the heart sounds will be replaced by a murmur, which can be heard best at the lower end of the breastbone. When the *mitral* valve is incompetent, allowing of a leakage back into the left auricle, the first sound of the heart will be replaced by a murmur—these murmurs being produced by the passage of the blood through a narrow into a wider channel. As a result of the blood current being either obstructed in its onward flow by *stenosis* of a valve, or regurgitating backwards owing to *incompetence* of the valve, changes take place in other organs. Thus the blood flows more slowly through the *lungs*, and leads to *congestion* in that organ; the *liver* becomes engorged with blood and greatly enlarged; the lining membrane of the *stomach* becomes swollen; the systemic veins cannot empty themselves freely, and this gives rise to *dropsy*, beginning in the feet and legs; the *brain* is not adequately supplied with blood, and consequently *sleeplessness* results. Whilst these are the *ultimate* effects of valvular disease, they do not arise at the very commencement of the changes, because the heart possesses a certain amount of *reserve force*, which comes into play as soon as the emergency arises, and which overcomes the difficulty for the time being; and then the heart-muscle gets much thicker and stronger—hypertrophies—and what is termed *compensation* results, and so long as this compensation is maintained, and the heart is enabled to cope with the altered state of affairs, no *symptoms* arise, and, in fact, the patient may be quite ignorant of the fact that his heart is affected; but a time comes when this *compensation fails*. The heart can no longer carry on the unequal struggle, and its walls begin to stretch and its chambers to *dilate*, and the result of this is shown in the *symptoms*, which now make themselves apparent; and amongst the earliest of these is *breathlessness* on exertion, due to the congestion in the lungs. Then *sleeplessness* comes on, the patient complaining that he starts up just as he is dosing over. Flatulent distension of the *stomach*, accompanied by *indigestion*, soon follows; the liver becomes enlarged; the *urine* is diminished in quantity, high-coloured, and contains *albumin*. The legs swell from *dropsy*, which gradually spreads upwards till it reaches the abdomen, and even the thorax. As a result of the congestion in the lungs, a *cough* is developed, accompanied by a watery expectoration, often

tinged with blood. The patient is unable any longer to lie down in bed, but has always to be propped up with pillows, and get what sleep he can in this position. Frequently, of course, valvular disease terminates in *sudden death*, and this is more particularly the case when the aortic valve is incompetent.

Treatment.—This naturally divides itself into the steps to be taken whilst *compensation* is maintained, and those when it begins to *fail*. During the former period drugs are not called for. The patient should lead a quiet life, free from worry and anxiety. He should take moderate exercise, avoiding all sudden strains, indulge in *tepid* not *hot* baths, eat moderately of easily digested food, abstain from alcohol, and ensure a regular movement of the bowels.

When the *first signs of failing compensation*, such as breathlessness, an irregular pulse and sleeplessness, make their appearance, *rest in bed* for a week or ten days often acts like a charm, and the untoward symptoms quickly disappear. When the case is advanced a stage further and *dropsy* is present, *digitalis* is the drug the patient must depend on; it steadies the action of the heart and makes it beat more strongly—10 drops of the *tincture* may be given three times a day to begin with. It may be given alone or combined with 20 to 30 drops of aromatic spirit of ammonia, and half an ounce of infusion of senega. Another drug whose action is somewhat similar to digitalis is *strophanthus*, it also steadies the heart, makes it beat more slowly, and strengthens its contractions; 3 to 5 drops of the tincture may be given three or four times a day. *Iron* in some form or other is often called for on account of the *anæmia* which is often present.

Free *purgation* is often of the utmost importance, and for this purpose a pill containing 2 grains of *blue pill* and 3 grains of the compound colocynth pill may be given from time to time; or, instead of this pill, 30 grains of compound jalap powder may be administered.

Sometimes the venous system becomes *suddenly* engorged, and it seems impossible for the heart to keep up the circulation. In such cases *bloodletting* affords immediate relief, all the breathlessness, lividity, and distress passing away after 10 to 20 ounces of blood have been withdrawn from one of the veins. For the *sleeplessness*, which is one of the most distressing symptoms, and present during the whole course of the disease, but more marked when compensation has failed, half a drachm of the spirits of *ether* or of spirits of *chloroform* given with some hot whisky and water, often gives a refreshing sleep, or half a drachm of

paraldehyde may be given in milk, or if the taste is objected to it may be made up into a draught with a drachm of syrup of ginger and half a drachm of mucilage together with an ounce of water. Should this fail, *morphia* must be given either by the mouth or *hypodermically;* one-sixth to one-quarter of a grain may be given at bedtime. For the *pain* and *palpitation,* which are sometimes very trying, an *icebag* applied over the heart is very soothing, and *iodide of potassium* in 10-grain doses three times a day also affords relief.

When symptoms of *indigestion,* accompanied by vomiting and nausea, make their appearance, it is well to limit the food to small quantities of milk to which some *lime water* and ice have been added, and to give a dose of the following effervescing mixture three or four times a day: Bicarbonate of soda, 3 drachms; cherry laurel water, 4 drachms; water to 6 ounces—an eighth part for a dose. Powdered citric acid, 2 drachms, to be divided into eight powders. A powder to be dissolved in a tablespoonful of water and added to a dose of the above mixture, and the draught to be taken during effervescence. Finally, when the whole body has become dropsical, it only remains to make punctures in the skin, and allow the fluid to drain off, and this can best be done with *Southey's tubes;* these are pushed into the skin of the legs with the help of a needle, this latter being withdrawn, leaving the tube in the skin, and through this the fluid drains away. Simple *punctures* are also efficient, but they must be made under antiseptic precautions.

The *diet* of patients suffering from heart disease is often difficult to manage, as they so frequently suffer from want of appetite, and nausea is so frequently present, but the rule should be to administer food in concentrated forms, and to avoid everything which causes flatulent distension of the stomach. Milk, eggs, meat juices, fish and fowl, should form the staple articles, and small quantities of sound whisky given from time to time.

Enlargement of the Heart.—The average weight of the human heart is about 11 ounces in males and 9 ounces in females. When, however, this organ becomes enlarged, from whatever cause it may amount to 16 to 20 ounces or even more.

Enlargement of the heart or hypertrophy has already been mentioned in connection with chronic disease of the valves, its commonest cause. Bright's disease of the kidneys is another frequent cause of the condition, but at present we are dealing with enlargements which arise independently of any other disease, and which may be termed *primary* in their origin. Any *cause*

which entails *increased work* on the part of the heart may result in its enlargement. We have seen that this is so in valvular disease, where the heart has perforce to work harder if the circulation is to be carried on at all, and where as a result it becomes enlarged. *Over-exertion* is one of the commonest causes of enlargement, apart from disease. Ordinarily when an individual exerts himself in some unusual manner, the effects of the strain pass off after he has had a rest, and the heart returns to its normal condition and no harm results, but sometimes it does not return to its normal state, but remains in a *strained* condition, and it is only after prolonged rest and careful treatment that the heart recovers. Such cases are met with amongst *cyclists*, who undertake long rides without any preparatory training; amongst people who visit mountainous districts during their holidays and attempt the ascent of great heights after having spent a sedentary life for eleven months of the year—in fact amongst all people who undertake hard physical exercise of whatever character without previous training. Prolonged over-exertion where the heart is constantly being called upon to use its reserve force also causes enlargement; consequently the condition is frequently met with amongst *miners* who lead laborious lives, constantly working with their arms and often in cramped positions. Soldiers who have passed through a long and arduous campaign are frequently affected. Athletes who lift heavy weights and give the usual exhibition expected from a "strong man" are another class who commonly suffer. The excessive use of *tea*, *tobacco*, and *alcohol*, all of which cause a *rapid action* of the heart, and thus increase its work may, and very frequently do, produce hypertrophy. The *physical signs* of an enlarged heart are a *bulging* of the chest wall which lies in front of the heart. If the hand is placed on the chest the *heart beat* is found to be forcible, and the chest is felt to heave under the blow of the heart muscle. The apex beat of the heart is found to be *much lower* than under normal circumstances, and in a line with, or even outside the nipple line.

When enlargement of the heart is the result of valvular disease, there may of course be no *symptoms* at all so long as compensation is maintained, these only declaring themselves when this fails. When it begins as an independent disease, however, the onset may be *gradual*, and the first unusual symptom indicating involvement f the heart may be *shortness of breath* on exertion, such as when a hill or mounting stairs. The *pulse* is more rapid, an irregular, or may be intermittent, dropping a beat every

then. Accompanying these symptoms is a sense of fulness and discomfort in the chest; and this is more marked when the patient lies down. When in bed the patient finds that he requires more pillows, as he cannot lie with his head low. *Pain* is a frequent symptom, more especially when the disease is due to the excessive use of tobacco. Headaches and flushing of the face are also common. *Palpitation* is another symptom frequently met with, and this may commence after some exertion, or even when the patient is resting quietly. Sometimes the symptoms commence *suddenly*, as for instance when a man, who is apparently quite well and strong, starts to climb a mountain, is suddenly attacked with shortness of breath, and a sense of oppression in the chest together with *palpitation*. These symptoms pass off when the individual rests; but recommence as soon as he attempts the same feat again. In such cases, what happens is that the heart or one or other of its chambers *dilates* and becomes overstretched from the sudden extra work thrown upon it, and it may be long before it quite recovers from the *strain*. The *treatment* of enlargement of the heart consists in the first place in removing the *cause* where this is practicable, the use of tobacco, tea, alcohol, must be discontinued, and violent exertion of every description avoided. *Rest*, however, is the chief indication, in bed for a considerable time, until the irregular rapid pulse quietens down, and the palpitation and difficulty of breathing disappear. Of drugs *aconite*, by dilating the capillaries and so allowing the blood to flow more freely through them, acts best in lessening the work of the heart; three to five drops of the *tincture* may be given three times a day. Bromide of potassium is another useful drug, and helps greatly to allay the *irritability* of the heart so commonly met with amongst hard smokers; 10 grains may be taken three times a day, or 20 to 30 grains at bedtime.

If cases of *heart strain* are neglected and allowed to go too far, they terminate, just as chronic valvular disease does in the failure of compensation, and all the symptoms which follow in its train.

D.A.H.—A condition of heart trouble, which has been brought much before the public since the war, is disturbed or disorderly action of the heart, commonly known as D.A.H. The symptoms are rapid action of the heart, shortness of breath on exertion, very often pain over the area of the heart, and all the symptoms of general nervous condition. On examination of the heart, however, we find that there is no enlargement, and, though a soft bruit or murmur is often heard, it is in the systolic period, and does not indicate any valvular trouble.

Treatment.—The treatment of this disorder aims chiefly at trying to restore the confidence of the patient as to his own condition, and in eliminating exciting causes, such as over-smoking, and worry of any description. He should be encouraged to take steady exercise, such as walking, swimming, golf, etc., while if the condition is acute, he should be treated with rest in bed and careful dieting. It must be borne in mind that D.A.H. is very frequently caused by some toxic or poisonous absorption into the system. The commonest of these toxæmias is caused by pyorrhœa (see Vol. I), or decaying teeth, so that the condition of the mouth is carefully examined and any defect of this kind is attended to. More obscure toxæmias occur from some absorption in the digestive canal of deleterious material, so dieting and regular action of the bowels must be secured.

Fatty or other degenerations of the heart can only be diagnosed by the intolerance of exercise and general condition of patients, where valvular disease is not present.

Treatment.—In cases of true fatty degeneration with a slow feeble pulse, faintness and pain, *rest in bed* is the best form of treatment, and together with this the administration of *stimulants* such as the aromatic spirit of ammonia, half to one teaspoonful in water three or four times a day, or alcohol which in some form or other is always called for, and *strychnia*, of which $\frac{1}{30}$ to $\frac{1}{15}$ of a grain may be given three times a day.

For the condition of the heart which is due to an excessive deposition of fat, in people who eat and drink too much and do not take enough of exercise, there are two methods of treatment which are deservedly popular; the one is the *Schott* treatment carried out at Nauheim, and the other is *Oertel's* treatment. The *Schott* method comprises *baths and resistance* [illegible] The water has chloride of sodium [illegible] and is further highly charged [illegible] ion of salines and gas vary according to the condition of the patient, as also does the *time* during which the individual is allowed to remain in the bath. The effect of the bath is to stimulate the skin circulation. The gymnastics consist in certain movements being carried out by the patient which are *resisted* by the operator or bath man. The result of the treatment is that the heart muscle is *toned up*, and any *dilatation* which may be present is removed.

Oertel's treatment consists in careful *dieting* which not only aims at the removal of fat, but also at preventing its formation, and in

regular active bodily *exercise* and gymnastics which strengthen the heart muscle—his objects are to improve the *tone* of the heart, to maintain the normal composition of the blood, to regulate the quantity of fluid in the body, and to prevent the deposit of fat. The tone of the heart is improved by walking exercise *uphill.* The patient has to walk uphill until *palpitation* comes on. He then stops till the breathing becomes easy again, but he must not sit down. The distance walked each day is noted, and gradually increased. To maintain the normal composition of the blood, the *food* must be largely of *nitrogenous kind*, fat, sugar, and starch being taken in very limited quantities. The lean of beef, mutton and veal, game, eggs, and green vegetables such as cabbage and spinach, form the staple articles of diet, whilst only from 4 to 6 ounces of bread are to be taken in the day. To reduce the amount of *fluid* in the body, the amount drunk daily is carefully regulated, and about 36 ounces, which includes the fluid in the solid food, is all that is allowed. The exercises already referred to encourage *perspiration*, which gets rid of much of the fluid in the body, but if these are not sufficient a course of *baths* with packing are prescribed. These should be taken twice a week for three or four weeks, and the course repeated three or four times in the year. To prevent the deposit of fat the following daily dietary is recommended:—

Morning.—One cup of coffee or tea, with a little milk, altogether about 6 oz. Bread about 3 oz.

Noon.—3 to 4 oz. of soup; 7 to 8 oz. of roast or boiled beef, veal, game, or not too fat poultry; salad, or a light vegetable; a little fish; 1 oz. of bread or farinaceous pudding; 3 to 6 oz. of fresh fruit for dessert. It is better to take *no liquids* at this meal, but in very warm weather 6 to 8 oz. of light wine may be taken.

Afternoon.—6 oz. of coffee or tea, with as much water; 1 oz. of bread as an exceptional indulgence!

Evening.—1 or 2 soft boiled eggs; 1 oz. of bread, perhaps a small slice of cheese; salad and fruit; 6 to 8 oz. of wine, with 4 or 5 oz. of water. A larger quantity of liquid than that prescribed should never be taken at one meal (Burney Yeo).

DISEASES OF THE BLOOD VESSELS

Arterio-Sclerosis.—Under this heading are included a series of changes, the result of *inflammation*, which takes place in the walls of the *arteries.* These changes may be widespread, involving the whole arterial system, or they may be confined to regions. such as the *arch*

of the aorta, that are most exposed to *strain*. They consist, in the localised variety, of *patches* of degeneration of the walls of the artery, which lead to their becoming thinner, and render them liable to dilatation, and hence to the formation of *aneurisms*. In the diffuse variety the walls of the arteries and capillaries become hard and non-elastic, and tortuous in their course; they are sometimes greatly thickened, so that the course of the artery can be easily followed, the thickening being due to the formation of *fibrous* tissue in their walls, hence the affection is sometimes spoken of as a *fibrosis* of the arteries. It will be readily understood that such changes offer a serious obstruction to the flow of blood through the body, and thus profoundly affect the *heart* and other important organs such as the kidneys and liver. The commonest *cause* of diffuse *fibrosis* of the arteries is *old age*, the sign of advancing years in the arteries being a hardening of their walls. In some men of course the arteries get hard much sooner than in others; some men *grow old* sooner than others. One often meets men of eighty-four and eighty-five who do not look more than sixty or sixty-five, and who are more active than many men at the latter age; and again, one often meets men of fifty or sixty who look twenty years older, and *are* as a matter of fact twenty years older, because their *arteries* are in a condition of degeneration which corresponds to a much more advanced period of life, so that it has come to be said with much truth that "a man is as old as his arteries." *Disease of the kidneys* frequently gives rise to these chronic changes in the arteries, but it must also be borne in mind that the changes in the arteries often give rise to kidney disease, and, as in the case of the hen and the egg, it is rather difficult to say which came first. Certain *poisons* circulating in the blood are a very frequent cause of the disease, and act either by irritating the walls or by altering the quality of the blood. Of such poisons *alcohol* is more often responsible than any of the others, but the poisons of *gout* and *syphilis* also provide a not inconsiderable proportion of the cases. With regard to *over-eating* as a cause of *arterio-fibrosis*, Professor Osler, of the John Hopkins University, Baltimore, says, "I am more and more impressed with the part played by over-eating in inducing *arterio-sclerosis*. There are many cases in which there is no other factor" (*verb. sap.*). The changes result, as has already been pointed out, in the arteries becoming hard, so that they feel like a pipe stem. The *pulse* is hard and difficult to obliterate. The *heart* becomes *hypertrophied*, and the second sound is greatly accentuated. The patient may suffer severe *heart pain* akin to *angina pectoris*, and eventually he may have all the symptoms—dropsy, difficulty of breathing, &c.—indicative of *heart failure*; further, he is liable to suffer from

apoplexy or hæmorrhage into the brain, and from convulsive attacks indistinguishable from *epileptic fits*. The *treatment* consists in leading a quiet regular life; seeing to it that the functions of the *skin*, *bowels*, and *kidneys* are active; living on plain wholesome food; avoiding excesses of every kind, and becoming a *teetotaller*.

Aneurism.—An aneurism is a *tumour* (Fig. 60) containing fluid or coagulated blood, and communicating directly with the canal of an artery. The limiting membrane of the tumour is called the *sac*. The tumour may be *sacculated*, as shown in the illustration, or *fusiform*; in the latter case consisting of a mere bulging of the wall of the artery.

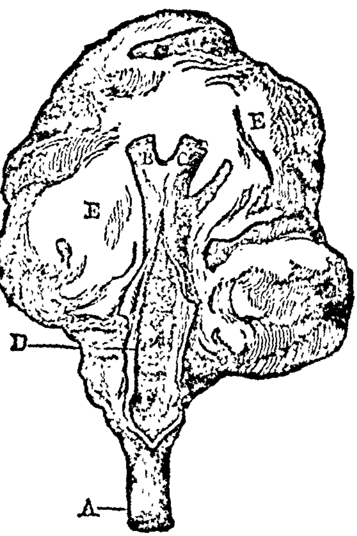


Fig. 60.—An Aneurism.
E, E, Sac of Aneurism; D, Aperture of Communication with Artery; A, Artery; B, C, Continuation of Artery.

Causes.—An aneurism is produced by a preliminary weakening of the wall of an artery due to the presence of *arterio-sclerosis* of the localised variety; superadded to this weakness a *strain* is thrown upon the particular portion of the artery, either as a result of *hypertrophy* of the heart or of over-exertion on the part of the patient, and the wall of the artery *stretches*. The current of blood continues to play on the weakened wall, and eventually a bulging or *tumour* forms. The inner coats of the artery at the affected area rupture, or become very thin, whilst the outer coat inflames and becomes greatly thickened. The blood in passing through an aneurismal dilatation tends to coagulate, more especially if the walls are rough, and thus the interior of an aneurism is frequently found to contain *fibrin* which is laid down in layers, so that a cross section through the tumour closely resembles that through an *onion*. Aneurism is an affection of middle age, from thirty-five to forty-five being the usual period of life during which it develops. Men are more frequently affected than women owing to the more strenuous life that the former lead. The poisons of alcohol, syphilis, and gout which produce arterio-sclerosis are the most frequent cause of aneurism, though it may arise in strong muscular young men who are in no way affected by the above poisons, but are exposed to the effects of *strain*; and thus men who are much engaged in *rowing* are frequently the subjects of the disease. The *symptoms* of aneurism will depend to a great extent upon the *position*

of the tumour, because these are in great part due to the *pressure* which the growth exerts on neighbouring tissues and organs. Aneurisms may be divided into *external*, or those which arise in connection with the extremities, and come under the supervision of the surgeon; and *internal*, or those which develop in some portion of the thoracic or abdominal *aorta*, and belong to the province of the physician. When the aneurism is situated in one or other of the *extremities*, the first symptom the patient usually experiences is *pain* of a neuralgic character affecting a nerve which lies in close proximity to an artery. Secondly, he may discover a swelling or *tumour* at the back of the knee for instance, or in the armpit; he may also notice that the tumour *throbs*. If pressure be applied to the artery at a point between the tumour and the heart, the swelling may disappear or become *flaccid;* whilst if the pressure is applied on the artery, on the distal side of the tumour, the latter may become much more *tense*. The *pulse* on the affected side may be altered, being slower and smaller than its fellow. On placing the ear against the tumour a *murmur* or blowing sound may be heard. When the tumour is situated in the neck the patient may suffer from *giddiness*, and if the nerve which supplies the larynx be pressed upon he may be *hoarse* from paralysis of the larynx. The internal aneurisms are divided into those affecting the *thoracic*, and those the abdominal aorta, and the *symptoms* produced by a thoracic aneurism will depend upon which portion of the artery, the ascending, arch, or descending, is affected.

Aneurism of the Aorta.—When the aneurism is situated in the ascending portion of the aorta, very near to the heart (Fig. 55), the only symptoms may be those due to dilatation and consequent incompetence of the aortic valves; such aneurisms do not grow to a very great size. When the tumour involves the ascending portion a little further away from the heart, *pain* in the chest is the first symptom experienced. Following this there may be a *bulging* of the chest wall to the right of the upper end of the *breastbone*, and if the hand is placed on the swelling it may be felt to *pulsate*. The pain sometimes shoots down the arm, and if the veins are pressed upon the arm may swell. On placing the ear against the chest wall over the tumour a murmur may be heard. When the tumour is situated in the *arch of the aorta* the symptoms are far more numerous, because then it comes into relationship with the *trachea* and *bronchi*, the *œsophagus*, the great *nerve* called the *vagus*, and the *sympathetic* nerves. It may also by steady pressure against the *spine* cause absorption of some of the bones. A *swelling* may be felt to the left side of the upper end of the breastbone, and the patient may complain of *pain* shooting down the left arm. The

pulse on the left side may differ from that on the right. As a result of *pressure* on the various strictures mentioned the patient may experience *difficulty in breathing.* He may have a peculiar ringing brassy *cough,* or one with a wheezy sound, which has led to its being designated the *gander cough.* Pressure on the gullet leads to difficulty in *swallowing.* There may be paralysis of the *vocal cords,* and if the sympathetic nerves in the neck are pressed upon there may be *contraction of the pupils* due to paralysis of these nerves, or *dilatation* of the pupil if the nerve is only irritated. When the tumour involves the descending portion of the thoracic aorta a swelling may develop in the *back.* The bones of the spine may be gradually eaten away by it, and *pain* will be experienced which generally shoots along one or other of the intercostal nerves which lie by the side of the ribs. It is sometimes very difficult to say exactly which part of the aorta is involved by the tumour, and then an X-ray picture is a great help.

When the *abdominal aorta* is affected the tumour lies just below the *diaphragm,* and can be felt in the pit of the stomach as an expansile, pulsating swelling. A blowing *murmur* can be heard by applying the ear to the abdominal wall; and if the tumour be a large one *no pulse* can be felt in the arteries of the lower extremity, though the circulation in the limb seems to be carried on as usual. The patient complains of *pain* and *vomiting.* The beating of the *aorta* in the abdomen has been frequently mistaken for an aneurism. The *treatment* of aneurism consists in employing means to *retard the circulation* and to favour the coagulation of blood within the tumour, and with these objects in view *rest* in bed in the recumbent position and a *restricted diet* have been advocated. The diet recommended by *Tufnell* of Dublin is the one usually adopted, but few people can submit to it for more than a few weeks, whilst he insisted that it should be persevered in for *months.* It comprised: *Breakfast*—2 oz. of bread and butter, 2 oz. of milk or tea. *Dinner*—3 oz. of mutton, 3 oz. of bread or potatoes, and 4 oz. of milk or claret. *Supper*—2 oz. of bread and butter, 2 oz. of milk. Of *drugs,* the only one which really seems to influence the growth in any way is *iodide of potassium,* which may be given in from ten to twenty grain doses three times a day. The *surgical* treatment of aneurism consists in introducing some foreign body such as horsehair or fine wire into the interior of the cavity, or of passing an electric current through it by means of *electrolysis needles,* the object of both procedures being to cause coagulation of the blood; but it cannot be said that the results are satisfactory, most of the cases terminating fatally within a few days after the operation. When the

aneurism is situated in one or other of the *extremities*, and within easy reach, surgical interference holds out better hope of success, much, however, depending on the shape of the tumour and upon the opening which leads from the artery into the sac. The means the surgeon adopts are either *compression* above, upon, or below the aneurism, or the application of a *ligature* to the artery above or below the tumour. But, after all is said and done, nothing we know of can remove the *cause* of aneurism; and although some cases do recover *spontaneously*—for cured aneurisms have been found in the bodies of people who have died from other causes—the disease eventually kills the victim either by bursting suddenly, when he dies immediately from hæmorrhage, or, as is more frequently the case, by the pain and anxiety which it gives rise to.

Nævus.—This is a disease in which the *capillaries* are affected and gives rise to "marks" on the body, which are variously known as *strawberry marks*, "birth marks," or "port wine stains." When pigment is present in the mark it constitutes a "mole." The disease consists in a localised *hypertrophy* of the capillaries. The "mark" may be rough and raised above the surface, or smooth and level with the surrounding skin. The marks are as a rule congenital, or appear shortly after birth. Their commonest site is in the head, and more particularly on the face and lip.

Treatment.—Many nævi need no treatment, but when they appear on the face and are apparently *growing*, the surgeon has to be consulted. When the affection consists in merely a staining of the skin, some form of caustic may be tried to remove it, such as painting it with strong nitrate of silver solution; but when it constitutes an actual tumour beneath the skin, the best treatment is to cut down upon it and *tie* the blood-vessels that feed it. Treatment by *electrolysis*, which causes coagulation of the blood contained within the tumour, is also attended with a large measure of success, but the growth can seldom be cured at one operation.

Vaccination over a small nævus sometimes results in its disappearance, but is not a very reliable measure.

Inflammation of Veins.—*Phlebitis* or inflammation in the veins very rarely commences in the veins themselves. The process generally spreads to them from the neighbouring tissues which are similarly affected, as for instance from a poisoned wound. *What the* older physicians thought was inflammation of the veins was really only *clotting of blood* in the veins, a result of their walls being weakened by the surrounding inflammation, and it is this clotting of the blood or *thrombosis* which gives rise to the *symptoms* of the disease. The blood clot or *thrombus* in the vein leads to *obstruction*

of the circulation through it, and causes *dropsy* of the limb if the blood cannot get round by some other route. The vein containing a clot can be felt all along its course as a hard cord. The blood clot may be entirely *absorbed*, leaving the vein in its normal condition, or it may permanently block the vein, so that the blood can never pass through it again. Sometimes, especially when the clotting in the vein has been the result of a *poisoned wound*, abscesses may form in the course of the vein, and general *blood poisoning* may result. The vein most frequently affected is the *saphena* vein, which runs up the inner side of the thigh just beneath the skin, and the disease is then generally the result of *varicose veins* in the leg. One form of disease shows itself in the *deep veins* of the thigh, is due to an altered condition of the blood which favours its coagulation, and attacks women a week or so after *childbirth*, giving rise to the disease termed *white leg.*

Symptoms.—The most prominent symptom of coagulation of blood in a vein is *dropsy* or swelling of the limb. There is in addition local *pain* and tenderness. In the condition termed *white leg*, the woman complains of *pain* beginning in the calf of the leg or in the thigh. Within twenty-four hours of the onset of pain the limb begins to swell. It is hard and tense, and of a shiny *white* colour. The temperature rises to 101° or 102° F. The pulse is quick and the patient is restless, and suffers from want of sleep. The acute stage of the disease lasts for a week or so, and then the symptoms begin to abate, but it may be weeks or months before the limb returns to its normal condition. Sometimes, as a result of *undue exertion* on the part of the patient, a portion of clot becomes separated, and is carried by the blood stream to the heart, and causes sudden death. *Treatment.*—This consists in keeping the patient absolutely at rest in bed. *Raising* the affected limb to promote circulation in the veins, and keeping the leg *warm* by rolling it in cotton wadding and applying warm fomentations, or linseed poultices and soothing applications, such as the belladonna and chloroform liniments to relieve the *pain.* In maintaining the patient's strength by administering *stimulants* when they are called for, and such tonics as quinine and iron. For the sleeplessness, Dover's powders in five-grain doses does well. The *diet* should be simple but nourishing. When the acute stage of the disease has passed away, the limb should be rolled in a flannel bandage to give it support and keep it warm, and all shampooing and massage of the limb should be avoided, as such practices have led to the *sudden death* of patients from the dislodging of a fragment of blood clot. The same remarks as to general treatment are applicable to coagulation of blood in veins wherever its site, with

this addition, that when abscesses form they should be opened at the earliest possible moment.

Varicose Veins.—When a vein becomes hypertrophied and

paralysis of the nerves which supply the veins, or to injury to the valves. The fact remains, however, that people who have much *standing* to do are frequently affected. *Constipation* and obstruction to the flow of blood through the veins in the abdomen, a result of wearing *tight bands* round the waist, are also considered to favour the dilatation of veins. Varicose veins *may occur in any region* of the body. Thus in the *rectum* they appear as piles, in the spermatic cord as varicocele, but their favourite site is in the superficial veins of the leg. As a rule the disease attacks the large veins, but sometimes, and this is more frequently the case in women, it begins in the very minute vessels, and then the skin of the affected area is marked by fine branching red lines, which are the dilated venous capillaries.

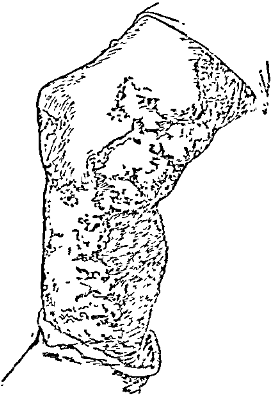


Fig. 61.—A Leg affected with Varicose Veins.

The *symptoms* in the early stages are not very characteristic, the patient usually complaining of being easily tired, or perhaps of *pain* in the leg which comes on after he has been *standing* for some time, or he may notice that the ankles swell. Eventually he notices that the veins are swollen and tortuous. The *skin* covering the veins becomes thin and glossy. Sometimes the surrounding parts become hard and brawny, and the skin becomes discoloured. As a result, probably of the feeble circulation, *eczema* frequently attacks the skin over the affected area, and if this be neglected, it may terminate in the *formation of an ulcer* which is slow to heal, and which may perforate the vein and lead to serious or even fatal hæmorrhage. The blood in the veins may coagulate forming a *thrombus*, and this

may become firm and hard and lead to an obliteration of the vein, or the clot may inflame and lead to the formation of local *abscesses*. The success or otherwise of the *treatment* will depend upon the stage at which the disease has arrived when it is taken in hand. In the early stages much may be done; in the later, nothing but a surgical operation can effect a cure.

When the disease is just commencing, *rest in bed* with the limb raised, to encourage the venous circulation, does much to restore tone to the veins. If this is impracticable, as it often is, a well-applied flannel bandage applied over the drawers *before the patient leaves his bed in the morning*, and when the veins in the leg are not nearly so swollen as when he is standing, and removed only after he gets into bed again at night, supports the veins and prevents their being engorged with blood. At the same time attention should be paid to the general health, and a dessert-spoonful of the following tonic mixture administered three times a day after food: Ammonio-citrate of iron, 80 grains; tincture of nux vomica, 2½ drachms; glycerine, 1 ounce, and water to 4 ounces. Saline purgatives, such as Apenta or Hunyadi Janos water should be taken regularly to promote the action of the bowels. The diet should be simple and nutritious, and stimulants should be avoided as far as possible. It should be a rule for the patient to rest his limb frequently during the day by sitting with it raised on a chair, and he should avoid standing about as much as possible.

When the disease is so far advanced that the above means are of no avail, the best hope of cure lies in removing the whole mass of dilated veins, as if they constituted a tumour, which they really do. When bleeding occurs from a varicose vein a firm pad and pressure should be applied over the bleeding point. In addition a bandage should be firmly applied above and below the wound, and the limb raised.

Bloodletting.—Though drawing blood from the veins is not nearly so frequently resorted to as it was fifty or sixty years ago, occasions still arise, such as when a patient is dying from distension of the right side of his heart, when it is of undoubted advantage. The operation itself is a simple one, and is generally performed at the bend of the elbow. The first step consists in rendering the veins prominent by tying a band firmly round the arm a few inches above the elbow; the band should be tight enough to render the veins prominent, but not so tight as to stop the pulse at the wrist. Next, having chosen the largest vein, and should this be the *outer* one so much the better, the operator places his left

thumb on the vein just below the point where he means to cut, and taking the scalpel in his right hand he makes a cut through the skin into the vein, taking care not to cut right through the vein, and above all that the wound is an *incised* one and not a *stab*. The blood is received into a basin, and after the requisite amount has been drawn off pressure is applied to the wound with the left thumb; the constricting band is removed, the limb is carefully cleaned and then a *pad* is fixed over the wound with a figure-of-eight bandage, the arm is bent at a right angle and placed in a sling. In three or four days when the pad is removed the wound will probably be found to have healed.

DISEASES OF THE BLOOD

The blood may be affected by disease, either in respect of its *quantity* or its *quality*. A person who has suffered from an accident involving the loss of a large quantity of the vital fluid, illustrates the first phase in question, while a patient suffering from say scurvy (vol. i.), or from *anæmia* or "bloodlessness," may be regarded as representing the second aspect of this subject.

Anæmia.—This affection is frequently spoken of as "bloodlessness." In its typical development it is seen in delicate girls. In them we find pallor or extreme paleness of the skin, lips, and gums. We come face to face here with a case in which the blood-quality is markedly altered. Anæmia may be naturally the result and consequence of this disease. After fevers or other weakening ailments we may find it present, while no doubt it is also caused by the use of improper foods, or by deficiency in the natural and proper amount of nourishment demanded for the support of the frame. A reference to the section of this work dealing with the composition of the blood, will show that *iron* is the chief constituent of the vital fluid which has to be considered in reference to anæmia and allied conditions. This iron is combined with the living matter of the blood-corpuscles, and is the main agent by means of which the oxygen, breathed in from the air, is conveyed to all parts of the body. If the supply of iron derived from the food is deficient, it is obvious that the proper functions of the blood cannot be discharged, and anæmia is therefore to be regarded as largely the result of the deficiency in question.

Chlorosis.—This ailment, otherwise known as "green sickness" from the pallor and greenish hue of the skin, is to be regarded as a form of anæmia. It affects females especially, and is due to a

deficiency in the *hæmoglobin* or iron compound of the blood. The *symptoms* of anæmia and chlorosis are very similar. The face is pale, and the lips and gums have a "bloodless" appearance. The system is disordered also at large. Constipation is common, and often a very troublesome condition. Loss of appetite is also experienced, and the heart is liable to disturbance of its action in the presence of the least excitement. The blood, examined by the microscope, is seen to be deficient in corpuscles, or at least to have its iron constituents reduced in amount. The heart sounds show decided alterations which the ear of the physician readily recognises. Frequently an anæmic or chlorotic patient may exhibit a stout build of body. This is due to the fact that, owing to an absence of the oxygen-carrying properties of the blood, fat, which should be utilised in the bodily processes, accumulates. Disturbances of the generative system are also common. Women complain when so affected of irregular menstruation, and they are frequently troubled with discharges from the womb, of the nature of "whites." Palpitation and breathlessness are also marked, and the patient as a rule is feeble and disinclined for exertion. Menstruation—that is, the monthly function—will usually be found to be disordered and irregular in the cases we are considering.

Treatment.—Obviously *iron* is the remedy upon which we have to rely in such cases, seeing that its deficiency constitutes a marked symptom of anæmia at large. Constipation must be corrected by the diet treatment described under the section of this work (vol. ii.) dealing with that subject. Cascara in the form of tabloids should be taken regularly, and the diet attended to according to the rules given in the section above alluded to. Iron may be given in various forms. Some authorities recommend that the bowels should first of all be made to act freely by the use of the compound decoction of aloes, say six ounces, to which is added two ounces of syrup of ginger, and six drachms of tincture of jalap; the dose of this mixture being a tablespoonful in water at night and in the morning. One of the best preparations of iron is the dialysed iron (Wyeth's), and this may be taken after meals in water thrice daily, in a dose of from fifteen to twenty drops. The iron should not be taken after tea or coffee. It is useful here to remark that the treatment of anæmia must be continued for a very long time in certain cases, and it will be well if the patient can secure a change of air, especially to the seaside. Such an addition of the treatment is of very valuable character. Iron is also given in such cases in the form of Blaud's Pills. Preferably, the tabloids corresponding to these pills may be used. The mode of using them is to begin by taking one pill thrice

a day, and increase each dose by one pill daily, till eighteen pills are taken in the day. Thereafter the dose may be decreased by one pill each day, until the original amount of three per day is reached. In the case of women, it is desirable to cease the iron administration when menstruation occurs. The food should be of a generous kind. A fair allowance of butcher meat should be given, and a glass of Burgundy at meals twice daily will probably be found an aid in the treatment. If for any reason the pills or the dialysed iron do not appear to be effecting an improvement, a mixture composed of citrate of iron and ammonia, ten grains; carbonate of ammonia, three grains; spirits of chloroform, fifteen minims, and water up to an ounce, may be taken after meals thrice daily. These quantities constitute one dose. Certain mineral waters containing iron are also useful in the treatment of anæmia. These are to be found at Harrogate in Britain, and abroad at Spa, Schwalbach, St. Moritz, and elsewhere.

Pernicious Anæmia.—This is a very serious disease, affecting patients between the ages of twenty-five and forty-five years. Here, the red corpuscles of the blood are markedly reduced in number, with the result of inducing symptoms which are characterised by the patient losing flesh, and developing a yellowish or waxy tint of skin. A certain amount of fever may be present, with alterations of the temperature which may occasionally fall below normal. Treatment here is very unsatisfactory, owing to our want of knowledge regarding the nature of the ailment. Arsenic is prescribed by physicians, given as a dose at first of three minims of the liquor arsenicalis after meals in water thrice daily. This dose is to be increased at intervals of four or five days to five minims, ultimately on the same ratio, arriving at a dose of ten to twenty minims.

Leucocythemia.—This name is applied to a disease in which a far greater number of white blood corpuscles than is normal is found in the blood. It affects men more frequently than women, and occurs mostly in middle life. The spleen, which we have seen to be concerned in the manufacture of white blood corpuscles, is enlarged, *while the liver also undergoes similar changes. Anæmia is a symptom* here, with rise of temperature. Bleeding may occur from the gums, nose, lungs, or other organs. This ailment is one which appears to tend towards a fatal termination, and the treatment, having regard to our want of knowledge as to the causation of the disease, is naturally unsatisfactory. As in the case of pernicious anæmia, arsenic is the drug mostly relied upon by physicians for relief.

Scurvy as a blood disorder has already been duly treated under the head of "General Diseases" in the first volume of this work.

"Bleeders" (Hæmophilia).—It is well known that the males in certain families show a curious characteristic marked by a tendency of bleeding from nose, mouth, and gums. If a scratch is neglected, the bleeding continues to an inordinate extent. The extraction of a tooth may give rise to hæmorrhage, which can be arrested only with great difficulty. Certain affections of the joints, and especially of the knee-joint, appear to be connected with this curious condition. It appears that children born with this "bleeding" tendency die in early life as a rule, but where they survive to adult life they remain in danger. It is stated that half a gallon of blood may be lost in such persons after a tooth has been taken out.

Causes and Treatment.—We probably meet here with some peculiar conditions, first of the blood itself preventing coagulation, and second, with a deficient power of contraction on the part of the blood-vessels. As regards treatment, it is recommended that the diet should be of a light character. The drugs used are saline aperients to regulate the bowels, when necessary, and tincture of the perchloride of iron, say, ten to fifteen drops in water after food, twice or thrice daily. This preparation may be used also to check bleeding locally, as described in the section of this work devoted to the consideration of hæmorrhage. Chloride of calcium, in doses of from twenty to twenty-five grains, may be given under the idea of increasing the coagulating or "clotting" qualities of the blood.

Purpura.—This name is applied to cases in which we find small escapes of blood from the finer vessels, appearing in the skin as spots, which vary in size from that of a pinhead to that of a pea. They first appear on the legs as a rule, and are named *petechiæ*. If they run together, they naturally form patches. Fever may be present, and if the bleeding affects deeper parts or membranes of the body, the result may be serious. Physicians are accustomed to recognise a simple form of "purpura" and an aggravated phase of the disorder. The latter form is associated with bleeding from the nose, gums, or even stomach. "Purpura" is regarded as having a certain relationship to scurvy itself, since in the course of that disease bleeding points may appear. The *treatment* is unsatisfactory, and it is remarked that what avails in scurvy, in the way of diet, has no effect in "purpura." Plain and non-stimulating diet, fresh air, and the taking of the tincture of the perchloride of iron in twenty drop doses, after meals thrice daily (or even larger doses), forms a mode of treatment practised by physicians. Turpentine is also used to check bleeding from internal surfaces. No stimulants should be given in this disorder.

ADDENDUM

Hernia *or* **"Rupture."**—This term is applied to the escape of a portion of the intestine (or bowel) either, as is common, in the region of the groin, or, as is not uncommon in infants, at the *umbilicus* or "navel." Owing to some weakness or other the bowel protrudes and causes a swelling. The danger here is that the portion of the intestine which thus protrudes may be so fixed that it becomes "strangulated," in which case an operation is demanded to allow of its being returned to the abdomen. "Rupture," in a simple case, is treated by the wearing of a proper truss, only this must be fitted by an experienced surgical instrument maker acting on the advice of a surgeon. Much harm may be done by the wearing of unsuitable trusses. A truss as a rule should not be worn in bed, and it is wise always to have a duplicate truss at hand, in case of injury to the one in use. In the case of hernia in infants the mother should early seek the services of the doctor. Rupture in infants as a rule can be readily cured.

Fistula.—This is a term which is used to indicate a tract or surface exhibiting no tendency to heal up, and connecting one part of the body with another. It is usually the result of an *abscess* (or collection of matter) which has burst through and left the tract in question. "*Fistula*" may occur in many regions of the frame. The most common is *fistula in ano*, where a tube-like passage opens from the bowel to the *anus* or "vent." In women fistulas are liable to occur in connection with the womb and bladder. Commonly a fistula discharges "matter" or other secretion, and constitutes a very annoying and painful complaint. No treatment is of service save that of surgical nature. The surgeon slits up the fistula, and converts it into a healing wound, which, duly repaired, so to speak, cures the disease.

Fissure.—This name applies to a very painful complaint affecting the *anus* or "vent." It is frequently mistaken for a pile (vol. ii.). Here we find a crack or fissure to be formed at the vent. It shows no tendency to heal, and each time the patient goes to stool he suffers excruciating pain. Bleeding also occurs as the result of bowel-action. The proper treatment is that which alone can be had at the hands of the surgeon, who, by aid of a simple operation, can heal up the fissure. The parts should be kept very clean, and if the fissure is of a simple nature, it may be well to apply pure hazeline as a lotion to it, or to use hazeline ointment. But in the majority of cases a simple operation cures the ailment at once.

SECTION IV

THE LUNGS AND THE FUNCTION OF BREATHING

In dealing with the functions of the skin and kidneys it was duly explained that these organs formed, with the lungs, a physiological trio. In other words, the three organs perform very much the same kind of work, that is to say, they discharge the function of excretion or the getting rid of that waste which represents the result of bodily work. Such forms of waste represented by heat, water, carbonic acid gas, mineral matters, urea and ammonia are separated from the blood by all three organs, the vital fluid being in this way purified. In addition, however, to the work of removing waste matters from the blood, the skin and the lungs in particular discharge a second duty. This duty is of course more conspicuously performed by the lungs than by the skin and kidneys. It consists in the absorption, or taking in, of *oxygen*, which passes inwards to the blood as part and parcel of the food-supply. It is this oxygen gas, derived from the atmosphere, which, carried to all parts of the body by the blood (as explained in the section of this work devoted to the circulation) is necessary and essential for the performance of every vital action. If dealing with the action of oxygen in relation to other foods we compare the latter to the coals and sticks in a grate, oxygen might be compared to the light without which the materials could not be combined in order to form the fire.

Respiration.—The function of the lungs is to discharge the duty of breathing, or as it is technically called, *respiration*. The high importance of this function can well be estimated from the fact that if the supply of oxygen to the body is interfered with even for a few minutes, as in the case of drowning and other forms of suffocation, death results. Respiration practically consists as we have seen of two actions. Of these the first is involved in the getting rid of the waste matters which have passed into the blood from the tissues and which are excreted by the lungs. In the second place the work of breathing includes the absorption of oxygen into the blood. This double duty is discharged by the lungs, so that when their functions are seriously interfered with we find death resulting, not merely from the deprivation of oxygen, but from the retention in the blood of carbonic acid gas and other waste matters. The simplest type of an organ of respiration is that found in certain

lower animals. If we conceive a thin membrane opening to air or water on one side, and having on the other side a network of blood-vessels through which blood is perpetually passing, we find in such an arrangement all the features of a "gill" adapted for the use of aquatic animals, and of a lung such as is found in animals which breathe air directly from the atmosphere. The waste matters contained in the blood strain or pass through the thin walls of the blood-vessels and through the membrane of the lung or gill, and are thus excreted from the body. At the same time an inward passage of oxygen takes place through the membrane and through the walls of the blood-vessels, thus gaining admittance to the blood. This idea of a breathing organ, simple as it is, represents the essential nature of the lung.

The Interchange of Gases.—It may be asked, however, how it is that the gases and other waste matters of the blood tend to pass to the outer surface of the body whilst oxygen passes inwards to the blood. There is a well-known physical law, named the law of diffusion of liquids. This law is expressed in the statement that, if two fluids of different densities be separated by a thin membrane, the liquids will tend to pass through the membrane and to mix until the density of the fluid on each side is equal. Thus, in one of the original experiments which demonstrated this process of *endosmosis*, as it is called, when a tube, one end of which bulged out and was closed with a piece of bladder, was filled with a solution of salt and dipped into a jar of water, two currents were seen to be set up. The water passed through the membrane into the salt, and thus increased the quantity of liquid in the tube. Conversely so much of the salt solution passed through the membrane into the water outside. It is through the operation of this law of diffusion of liquids that plants are enabled to suck up their liquid nourishment from the soil, and that animals are so enabled to absorb substances from the digestive system where no actual opening exists. With respect to gases, the law known as that of the *diffusion of gases* may be said to operate in the same fashion. In a simple experiment, a glass jar is filled with carbonic acid gas whilst another contains oxygen. If the jar containing the oxygen be placed mouth downwards on the jar containing the carbonic acid, the two gases will tend to diffuse; so much of the carbonic acid passing upwards and so much of the oxygen passing downwards until a mixture of the two gases is attained. But gases will also pass through a membrane, and in the case, say, of a closed bladder filled with oxygen gas and placed amongst carbonic acid gas, the oxygen will pass through the bladder to mingle with the carbonic acid gas, whilst the latter gas, in turn, will pass inwards to mingle

with the oxygen. If the bladder be moistened, this interchange of gases takes place with greater rapidity.

Interchange of Gases in the Lungs.—Returning now to the essential idea of the lung, we see that in the blood-vessels of the lung blood containing oxygen and carbonic acid gas is present. In the air-cells of the lung a similar mixture of gases is found. As the blood in the vessels is only separated from the air in the air-cells of the lung by the thin membrane consisting of the walls of the blood-vessels and of the air-cells of the lung, and as this membrane is perpetually kept in a moist state by the blood in the blood-vessels on the one side and by the secretions of the lungs on the other, we find that the law of diffusion of gases perfectly explains to us how oxygen passes from the lung into the blood and how carbonic acid gas conversely leaves the blood and gains admittance into the air-cells of the lung, whence it is breathed out.

The Air we Breathe.—In order more perfectly to understand how this interchange of gases occurs in the lung, it is necessary we should take some account of the air we breathe. Roughly speaking, atmospheric air may be considered to consist of 21 per cent. of oxygen and 79 per cent. of nitrogen, calculated by volume. If calculated by weight the proportions stand about 25 per cent. of oxygen and 75 per cent. of nitrogen. Ordinary pure air, however, in addition, contains about four parts of carbonic acid gas in 10,000 of air and a varying quantity of watery vapour, traces of ozone, ammonia, and of nitrous and nitric acids. In addition, a certain amount of *floating dust* is contained in the atmosphere, this consisting of inorganic or mineral dust and of particles of organic or living nature. This latter description of dust includes the multitudes of germs or microbes which the air contains; some of these existing in a dead and others in a living state. When we come to compare the air which is given out from our lungs with the air which is inspired from the atmosphere, we find, as might be expected, very material differences represented. These variations, of course, are due to the fact that the expired air contains waste matters which have been derived from the blood. Thus, if we assume that in fresh air the oxygen amounts to 20.8, the nitrogen to 79.2, and the carbonic acid to .04, the proportions of these gases respectively in the air breathed out is found to be oxygen, 15.4; nitrogen, 79.3; and carbonic, 4.3. Roughly calculated, we thus find that the air we breathe out contains about 5 per cent. more carbonic acid and about the same amount less oxygen than the air breathed in. This disparity is easily accounted for, because, as we have seen, so much of the oxygen contained in the expired air passes into the blood, whilst so much carbonic acid, representing waste, is passed

from the blood into the lungs. In addition to the carbonic acid gas we find that the air which is expired contains other waste matters. These are represented by heat (the expired air is practically the temperature of the blood), by ammonia, by water, and by traces of organic matters. These last represent the worn-out particles of the body. The organic matter in expired air becomes of extreme importance from a health point of view. It is this matter which causes ill-ventilated rooms to present a close, disagreeable, and stuffy odour. When it accumulates in large quantities, as in the case of slum dwellings, and where dirt and over-crowding are represented, this organic matter forms the special soil in which the germs of typhus fever breed and multiply. It may be mentioned that in so far as the quantity of oxygen and carbonic acid gas in the blood is represented, we find that pure or arterial blood contains about twenty volumes of oxygen in a hundred volumes of blood, and thirty-nine volumes of carbonic acid. In venous blood the quantity of oxygen sinks from eight to twelve volumes, whilst carbonic acid is increased to forty-six. It may be added here that the nitrogen of the air is an element which may be neglected in so far as any effects on the body are concerned. Its mission seems to be that of simply diluting the oxygen of the air. In the blood the quantity of nitrogen gas practically remains the same and is estimated at from one to two volumes in the hundred.

It is generally estimated that in the case of an adult man not performing hard work about 18 cubic feet of oxygen gas represents the amount daily taken into his lungs, that amount of carbonic acid gas being excreted. Naturally these quantities vary according to age, sex, chest-capacity, work, and other conditions of life. With regard to the water given off from the lungs about half a pint per day may be regarded as the average.

Air in Relation to Breathing.—We have already noted the composition of the air we breathe, but it is necessary to inquire more particularly into the amounts of air which are taken in and exhaled from the lungs under different circumstances. Taking the quantity of air which enters the lungs at each inspiration in ordinary, quiet breathing, to amount to 30 cubic inches, and the amount exhaled to represent a similar quantity, we find that an additional quantity of air is capable of being taken in through the operation of a deep breath. Physiologists calculate that an additional quantity amounting to 100 cubic inches of air may be inspired when a very deep breath is taken. A deep expiration in the same way causes the lungs to part with 100 cubic inches, in addition to the ordinary 30 cubic inches of quiet breathing. Various names have been applied to the different amounts of air which can thus be inhaled and exhaled from

he lungs. It is necessary, however, to observe that by the deepest ossible breath we cannot exhaust the lungs completely of air. Thus certain amount of air remains in the lungs in order to equalise the ressure of the outside atmosphere on the chest walls. If the lungs ould be completely emptied of air the pressure of the external air rould practically crush in the chest. Hence the amount (about 100 ubic inches) which always remains in the lungs over and above the eepest breath that can be given out is named *residual* or *safety air*. 'he amount passing in and out in an ordinary quiet breath is called *idal air*. The additional amount of 100 inches which can be taken n by aid of a deep breath represents the *complemental air*, whilst he corresponding 100 cubic inches exhaled by aid of a deep breath s termed *supplemental air*. If we add these together we see that he average capacity of the lungs of a man amounts to about 330 ubic inches. What is known as the vital capacity of the chest or ungs is practically represented by the power of giving forth by deep breath 230 cubic inches of air, this amount consisting of the *idal*, *complemental*, and the *supplemental air*, leaving of course in he chest the 100 cubic inches of *residual air*. The vital capacity of the chest in woman is somewhat less than in man, but as regards he exact construction of the chest it depends on stature, weight, size of body, and other bodily features.

The number of respirations per minute varies at different ages. At birth the number averages from 42 to 44 per minute. Between one year and five the number sinks to 26; from fifteen to twenty years t is represented by 20 respirations per minute; whilst from twenty to twenty-five years of age the number is 18; from twenty-five to thirty 16; and a rise appears to take place between thirty and fifty, seeing that between the latter ages the normal number of respirations is generally calculated to be 18. In extreme old age the number is lessened, and may fall from 12 to 13 per minute.

The Lungs and their Connections.—The organs of breathing not merely include the lungs themselves, but also the *trachea* or *windpipe* (Fig. 62, 3), and the *larynx* or *organ of voice* (1, 2), placed at the top of this latter tube. In so far as the mechanism of breathing is concerned we have also to take into account the structure of the chest, which has already been fully described in the second volume of this work in the section dealing with the general anatomy of the body. We have only here to remind ourselves that the *chest* or *thorax* is formed behind by the twelve vertebræ of the back, by the twelve pairs of ribs given off therefrom, by the rib cartilages which join so many of these ribs to the breastbone, and by the breastbone itself. We find the lungs thus contained in a

cage (Fig. 63) possessing elastic and movable walls. The chest, it may be remarked, is separated completely from the abdomen (or belly) below, containing the organs of digestion, by a large muscle called the *diaphragm* or *midriff* (*e, g*). This muscle will be hereafter shown to be the chief agent in breathing.

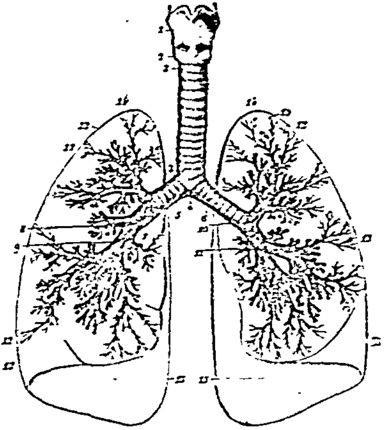


FIG. 62.—The Divisions of the Windpipe in the Lungs.

1. Thyroid Cartilage; 2. Cricoid Cartilage; 3. Windpipe; 4. Division into 5 and 6, the Bronchi; 7. Main Branch to Upper Lobe of Right Lung; 8, the Middle Lobe; 9, the Lower Lobe; 10 and 11 Branches for Left Lung; 12, the ultimate ramifications of the Bronchi before they end in the Air Cells; 13, 13, Outline of Lungs; 14, 14, the Apex of each Lung; 15, 15, the bases of the Lungs.

The Trachea or Windpipe.—The *trachea*, or *windpipe* (Fig. 62, 3), may be regarded as commencing at the lower end of the organ of voice, which is situated at its top, a point represented by the body of the sixth vertebræ of the neck. In length it is about $4\frac{1}{2}$ inches long, and extends downwards to the level of the fourth vertebra of the back. Here we find it divided into two main divisions called *bronchi* (5, 6), one passing to each lung,

In width the windpipe averages about one inch. It is of rounde shape in front, but exhibits a flattened aspect behind, where i rests on the gullet. A familiar observation teaches us that the windpipe contains rings composed of cartilage or gristle, these rings being joined together by a tough membrane. The rings on the windpipe however are not complete, seeing that they extend round the front portion alone. The object of the windpipe being thus converted into an elastic tube through the presence of the cartilage-rings just alluded to, is that of keeping the tube patent and open in all movements of the neck. In this way the supply of air to the lungs is in no way interfered with. We can appreciate the greater necessity for such an arrangement of the windpipe in a bird like the swan possessing an elongated and flexible neck. Certain muscular structures are also found connected with the windpipe, especially at its hinder portions. The windpipe is lined by mucous membrane, essentially similar to that found in the mouth and throat, but exhibiting a marked difference in that the cells of the windpipe are of the variety known as *ciliated cells*. Each of these cells possesses at its tree edge a fringe of hair-like, or thread-like, filaments of protoplasm, or living matter, known as *cilia*. These *cilia* exist in a state of continual motion, waving backwards and forwards, their object being to waft upwards towards the mouth the secretion of the ungs, whilst the upward current thus created by the movements of he cilia tends, in some degree at least, to prevent the entrance of ust into the lungs. It may be added that ciliated cells of the same ind are found in the air tubes of the lungs, which, it will be underood, are the continuations of the windpipe branching out into the ngs themselves.

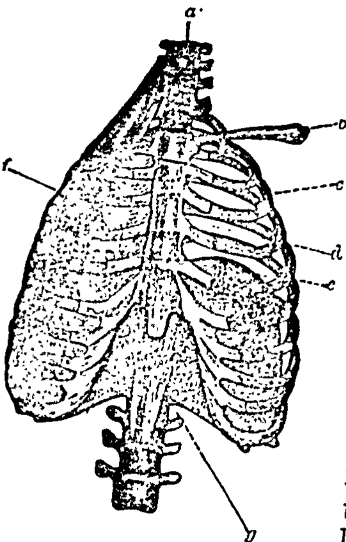


FIG. 63.—The Chest and its Muscles.
a, Spine; b, Collar-bone; c, Rib; d, Breast-bone; e, Diaphragm; f, Intercostal Muscles; g, Pillar of Diaphragm.

The Larynx or Organ of Voice.—The *larynx* or *voice-box* have seen to be situated at the top of the windpipe. It lies mediately below the tongue, being connected with that organ. e front of the larynx is marked by the projection familiarly known " Adam's apple." At its upper extremity the windpipe opens into larynx or back part of the throat. Here we find

(Fig. 64, *a*) which, in the act of swallowing, closes so as to prevent food gaining admittance to the trachea. This particular action will be found described under the head of the digestive system. The organ of voice is composed of certain definite pieces or elements composed of cartilage or gristle. It is also fully supplied with muscle and with ligaments. The chief cartilage of the larynx is that known as the *thyroid* cartilage (Fig. 62, 1), which consists of two curved portions joined in front but separated behind. It is this cartilage which forms in front the projection known as "Adam's apple." Each half of the thyroid cartilage gives off what is known as the *superior cornu*, by means of which the larynx is attached to the hyoid bone. Below, each gives off a second projection called the *inferior cornu*, these latter joining another cartilage of the larynx called the *cricoid* cartilage (2). Here we find a distinct joint formed between the two cartilages, so that the thyroid cartilage moves on the other to which it is attached. The cricoid cartilage is generally described as being shaped somewhat like a signet ring. In front it is of narrow shape, but is deep behind. The deeper part is situated in the space between the two wings of the thyroid cartilage. In front the cricoid is narrow, and the space between it and the thyroid is closed by a membrane. It should be noted by ambulance students that it is in the space just described, that an opening can be made in cases of choking caused by some obstruction to breathing situated higher up.

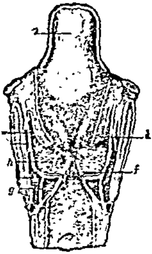


FIG. 64.—The Larynx Opened.
a, Epiglottis; *b*, Upper or Superior Vocal Cord; *f*, Inferior Vocal Cord; *g*, Thyro-Arytenoid Muscle; *h*, Ventricle of Larynx.

The operation in question is known as *laryngotomy*. An operation on the windpipe (*tracheotomy*), on the other hand, indicates the operation wh[illegible] itself. Other tw[illegible] in the larynx. [illegible] the cricoid cartilage itself. Each of these latter cartilages is of a somewhat triangular or pyramid-like shape, and to them the true vocal cords (Fig. 64, *f*) concerned in the production of voice are attached, whilst connected to them we also find certain muscles which have the function of opening and closing the aperture of the windpipe known as the *glottis*. The *epiglottis* lies behind "Adam's apple," and is attached to the inner surface of the thyroid cartilage. The epiglottis itself is connected to the tongue and

the arytenoid cartilages, whilst muscles are also provided for its movements.

The Lungs.—The lungs may be described as essentially consisting of two sacs or bags situated in the chest and communicating as we have seen with the outer surface of the body by means of the *windpipe* or *trachea* (Fig. 65, 3). The chest has already been described as being completely separated from the abdomen or lower cavity of the body by the great muscle known as the *diaphragm*

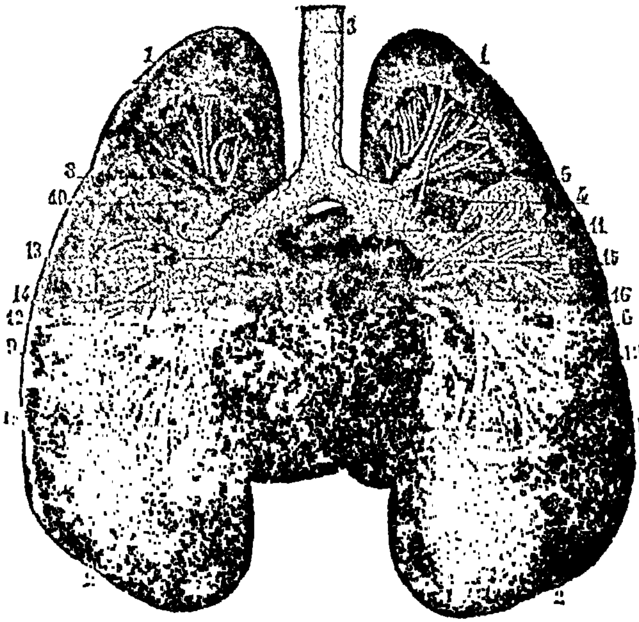


FIG. 65.—The Heart, Lungs, and Windpipe, seen from behind (partially dissected).

1, Apex of Lung; 2, Base of Lung; 3, Lower part of Trachea; 4, Right Bronchus; 5, Division of Bronchus; 6, Division of Bronchus below; 7, Left Bronchus; 8, Division of Right Bronchus above; 9, Division for lower part of Lung; 10 and 11, Branches of Pulmonary Artery; 12, Heart, Left Auricle; 13, 14, Pulmonary Veins, left; 15, 16, Right Pulmonary Veins; 17, Termination of Vena Cava Inferior; 18, Left Ventricle of Heart; 19, Right Ventricle.

or *midriff* (Fig. 63, *e*, *g*). In texture the lungs are of spongy character, a fact which may be verified by examining the lungs of a sheep or bullock in a butcher's shop. In man they are organs of a slaty blue tint. In the infant they are of a pink hue, the change of colour in the adult being due in all probability to the inhalation of dust particles. Hence persons living in a very impure atmosphere have blacker lungs than other people, a fact exhibited by the ailment known as "Miner's Lung," where in consequence of the breathing of coal dust the lung substance becomes loaded with

particles of carbon, this condition frequently giving rise to an acute form of tuberculosis. The lungs well-nigh completely fill the cavity of the chest. The right lung is somewhat shorter whilst it is also broader and somewhat heavier than the left. This lung is divided into three lobes or divisions, whereas the left lung exhibits a division into two lobes. In addition we find in the left lung a depression on its front border caused by the presence of the heart. In shape each lung may be described as being roughly conical. The top portion which rests under the collar-bone at the top of the chest is called *the apex of the lung* (Fig. 65, 1, 1). This portion of the lung in fact rises above the collar-bone to the extent of an inch or an inch and a half. The base of the lung is in contact with the diaphragm or midriff forming the floor of the chest. The base is somewhat concave, so that the convexity of the diaphragm passes into it. The hinder border of the lung is rounded and is of somewhat thick form. It rests in the hollow at the side of the spine. The front of the lungs is narrower and in a certain degree overlaps or covers the heart contained in this pericardium or back.

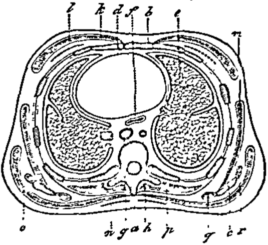


FIG. 66.—Transverse Section of Chest.
a, Eighth Dorsal Vertebra; *b*, Sternum; *c*, Shoulder-blade; *d*, Pericardium; *e*, Lung; *f*, Gullet; *g*, Aorta; *h*, Vein; *k*, Great Pectoral Muscle; *l*, Small Pectoral Muscle; *m*, Rib; *n*, Trapezius Muscle; *o*, *p*, *q*, *r*, Muscles.

The Pleura.—The chest is lined by a serous membrane called the *pleura*. This layer somewhat resembles the pericardium or sac of the heart, in the sense that it consists of two layers. One of these layers of the pleura lines the chest wall or inner surface of the ribs. It also passes to the upper surface of the diaphragm and is reflected to the back of the chest. Thence it passes to the root of the lung, covering the whole surface of the lung adhering to the lung itself. The practical effect of this arrangement is that in the movements of breathing the layer of the pleura covering the lungs rubs against the layer lining the chest. As these are smooth membranes, and as a small quantity of fluid is thrown out between the two layers, the movements of breathing are thus rendered smooth and undue friction avoided. Inflammation of the pleura constitutes the disease known

as *pleurisy*, and the physician is enabled by listening to the sounds of breathing to distinguish by their altered character, in respect of roughness and other points, the differenee between the normal and natural sounds of respiration and those characteristic of the ailment just named.

It must be understood, however, that each lung is practically free in the chest, save for the portion next its root (Fig. 65, 13, 14, 15, 16) where the divisions of the windpipe and also the blood-vessels going to and coming from the heart enter. At the root of the lung we find the *bronchi* or divisions of the windpipe (Fig. 65, 7, 8), and also the two pulmonary arteries carrying blood to the left auricle of the heart, and the two pulmonary veins (10, 11, 13, 14) carrying pure blood back to the left auricles. Here also at the root of the lung we find the nerves of the lungs as well as the other certain structures in the shape of the lymphatic or absorbent vessels.

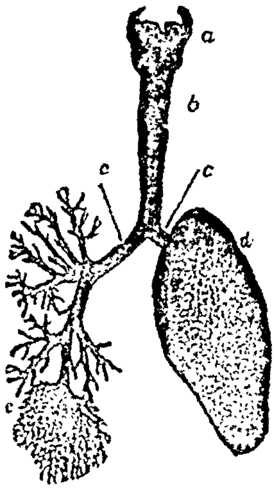


FIG. 67.—Lungs and Bronchial Tubes.

a, Larynx; *b*, Windpipe; *c*, its Division with Bronchi; *d*, Lung; *e*, Divisions of Bronchial Tubes in Lung.

Structure of the Lungs.—If the outer surface of a lung be even casually inspected it is seen to be divided into a large number of small portions known as *lobules* (Fig. 65). To understand the structure of the whole lung it is only necessary to investigate the structure of one lobule, seeing that each lobule resembles all its neighbours. We have seen that the windpipe at the root of the neck divides into two main branches termed *bronchi*. Each bronchus enters the lung of its own side and immediately begins to divide and subdivide within the lung into smaller and smaller tubes known as *bronchial tubes* (Fig. 67, *e*). The smallest of these tubes may be regarded as being about the one-fiftieth part of an inch in diameter. In this way, through the whole substance of the lung, air is conveyed from the atmosphere in the act of inspiration, whilst conversely waste matters coming from the blood into the lung are exhaled or breathed out. The whole arrangement of the windpipe and bronchial tubes of the lungs may be accurately enough compared in conformation to a tree (Fig. 67). If we could suppose the windpipe and the bronchial tubes separated from the lungs to be reversed, the windpipe would form the stem of the tree, the bronchi its two main branches, and the bronchial tubes the twigs into which the branches divide and subdivide. The bronchial tubes resemble the

windpipe in their structure. In their walls we find the gristly elements seen in the windpipe, these elements serving to maintain the bronchial tubes in a patent or open condition so as to allow a constant and easy passage of air in and out of the lungs. In the disease known as *asthma* there is represented a spasmodic contraction of the little muscles with which also the bronchial tubes are provided, and it will likewise be understood that the ailment named *bronchitis* represents an inflammation of the lining membrane of these tubes. If we trace one of the last twigs of the windpipe *in the shape* of one of the little bronchial tubes into the lung, we find it to end in a little passage of a somewhat larger diameter than the tube itself. Around this passage (Fig. 68, 2) we find opening a large number of little sacs or compartments which are the *air cells* or *alveoli of the lung* (3). *They may be compared to* rooms the doors of which open into a central passage. These air cells vary in diameter from the fortieth or fiftieth part of an inch to the seventieth part of an inch. The whole lung might thus be described as essen*tially consisting of a bag of air cells. It is a collec*tion of these air cells which go to make up each lobule of the lung. The walls of each lobule are of a remarkably thin description. Here we find represented the thin membrane which, in an earlier part of this section, we saw to constitute one of the essential features of an organ of breathing. We must also take account of the important fact that in the walls of the air cells we find a dense network of capillary blood-vessels. This network represents at once the ultimate branching out of the pulmonary arteries bringing impure blood into the lung from the left side of the heart, whilst it also represents the commencement of the pulmonary veins which return the purified blood from the lung to the left side of the heart for re-circulation through the body.

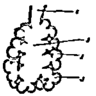


FIG. 68.—The Termination of the Bronchial Tube in the Air Cells of the Lung.

1, End of the Tube; 2, the Main Passage of the Lobule; 3, Air Cells.

We have now before us all the essential details included in the structure of the lung, and if to our former comparison that the lung may be described as a bag of air cells we add that its structure also includes a dense network of blood-vessels communicating with each side of the heart, we shall have formed an essentially correct yet simple idea of the nature of our breathing organs.

The Movements of Breathing.—In order to understand the manner in which the movements of breathing are carried out, we must remind ourselves that the floor of the chest is formed by the "diaphragm" or "midriff" (Fig. 63, *e*, *g*), the great broad muscle separating the chest above from the abdomen below. Seen in t

resting state, the diaphragm exhibits a kind of dome-like structure running across the lower part of the chest. The convexity of the dome lies towards the chest side, whilst the hollow is on the side of the abdomen. If we therefore could suppose the chest to be a room within which we could stand, the floor on which we rested would be curved. If, on the other hand, we supposed the abdomen to be a room, the roof over our head, formed by the diaphragm, would be hollow. The diaphragm is attached to the bodies of the vertebræ, and it is also connected to the six lower ribs. The tendon of this great muscle (*g*) exists in the middle, whilst the parts by which it is connected with the vertebræ are in part muscular and in part consist of tendon. Openings occur in this great muscle for the passage of blood-vessels, and also for the transmission of the gullet and nerves. This muscle is the great agent in *inspiration* or *breathing in.* When we take in a breath, the diaphragm comes into action and contracts. The sides being fixed to the ribs, the centre is naturally the chief point affected by the contraction, and the muscle is lowered. In taking a deep breath in, however, the diaphragm becomes less convex. It descends, and in this way increases the depth of the chest. It will be remembered that the ribs are movable on the spine, which last forms the fixed point for the movements of breathing. We must also take into account the fact that the front portions of the upper ribs consist of gristle or cartilage, imparting, therefore. an additional elasticity to the thorax. In the act of inspiration the muscles between the ribs (intercostal muscles) (Fig. 63) cause the ribs to rise. As the ribs are thus elevated, they necessarily push the breastbone forward. We thus see that by these connected actions the chest is not merely enlarged from side to side, but is also increased in length and in depth. This constitutes the act of inspiration, which may therefore be described as a forcible muscular act. It is, however, different in the case of *expiration* or *breathing out.* This is an action largely affected by what may be called the elastic recoil of the chest. If we note the breathing movements in ourselves, we can readily note the difference between them. Inspiration is found to be an act associated with an expenditure of muscular power, whereas expiration, in popular language, is effected, so to speak, by letting the chest go, so that the parts forced out of their resting position by inspiration return to that position when the act of taking in a breath has come to an end (Fig. 69).

The Action of the Lungs.—When the chest becomes enlarged, the lungs, which are highly elastic, yield to the pressure of air and expand, so that air enters and fills the air cells. When inspiration has ceased and expiration takes place, the recoil of the chest com-

pressing the lungs forces the air outwards, this action, however, being assisted to a certain extent by the muscles of the abdomen, and also by certain muscles of the trunk. In expiration also there can be little doubt that the muscular tissue of the lungs, which has been put on the stretch by the expansion due to inspiration, also assists in the work of expiration. In the case of what has been termed *forced breathing*, where an additional quantity of air is taken into the lungs, or where, on the other hand, in a diseased condition, such as asthma, where there is a resistance of the bronchial tubes themselves to the incoming of air, additional muscles may be called into action. It is in this way that disturbed breathing may be assisted by grasping some fixed object above the head. Here, the muscles which connect the arms and the shoulders to the chest are brought into play in assisting inspiration.

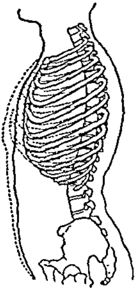


Fig. 69.—Diagram showing the position of Ribs and Breastbone at rest and (dotted lines) in inspiration.

Differences in Breathing.—The type of breathing in man and also in children is that known as *abdominal* or *diaphragmatic*. It is called so because only the diaphragm or midriff appears to carry on the chief share of this work. In males, therefore, and in children the movements of the walls of the belly are much more distinctly marked than in women. In them we find what is known as *costal* or *rib-breathing*, the ribs taking a more prominent share in the work than in the male sex. Infants breathe typically in the abdominal fashion, and mothers should bear in mind, therefore, that the presence of any tight bandages round the infant's belly must seriously interfere with the freedom of its respiration. In all probability the costal or rib type of breathing seen in woman has special reference to her functions in child-bearing, leaving the abdominal organs less disturbed than in the other type.

The Nervous Regulation of Breathing.—Breathing is one of those actions which are carried on practically independently of our will. It may be described in its essential nature as being of *involuntary character*. It differs, however, from a purely involuntary action like that of the heart, in that it is susceptible of being to a certain extent affected by the will. We can, in other words, for a certain time voluntarily arrest the movements of breathing. The high importance of respiration, however, as a function intimately connected with the preservation of life, no doubt accounts for its typically

involuntary nature, seeing that not merely during the day, but during sleep, when all voluntary control of the body is abolished, we find the action carried on perfectly under a nervous control for which we are not ourselves directly responsible. The nerves of the lungs are derived from both nervous systems, that is to say, from the system of which the brain represents the head, and from the sympathetic or involuntary nervous system. The control of breathing appears to be specially vested in what is known as the *respiratory centre.* This centre is situated in the lowest portion of the brain situated at the top of the spinal cord, in that region known as the *medulla oblongata.* The chief nerve which appears to regulate the movements of breathing is a branch of the large nerve known as the *vagus* or *pneumogastric nerve* (Fig. 59, *Y*). This nerve, which has a wide distribution to the heart and other parts, sends a branch into the lungs. It is evident, however, that if nervous control be thus exercised over the lungs themselves, the respiratory centre, which may be regarded as a kind of sub-office guarding the interests of breathing, possesses means whereby nervous messages can reach it from the lungs in turn. There can be little doubt that the stimulation which is necessary to keep the movements of breathing continuously carried on, comes from the nerve centre just described.

SECTION V

DISEASES OF THE LUNGS

Acute Nasal Catarrh, or a *cold in the head*, is an excessively common affection, some people having a distinct predisposition to the disease, more especially in the spring and autumn. *Causes.*—The most frequent cause is exposure to cold after having been in a close atmosphere for some time. Cold feet frequently result in an attack. Exposure to the fumes of chemical substances, such as iodine, bromine, and ammonia, often give rise to it. Finally, it must not be forgotten that a cold in the head is always the first symptom of *measles*, and also of serious varieties of *influenza.*

Symptoms.—The patient complains of *chilliness* and of a feeling of lassitude. There is dryness and obstruction of the nose, an uncomfortable feeling of dryness and itching at the back of the throat, and *sneezing.* These preliminary symptoms are quickly followed by a copious watery irritating discharge from the

nose, which causes redness of that organ and also of the upper lip. The eyes are painful and watery, and the head aches. If the affection spreads to the larynx there is a dry irritating cough. Deafness and noises in the ear are a frequent accompaniment, and the senses of smell and taste are as a rule completely lost. There may or may not be a slight rise in temperature; the urine is high coloured, the whole body aches, and the patient feels supremely uncomfortable. Within two or three days the watery discharge becomes turbid and purulent, and the obstruction to breathing through the nose is greatly relieved, and in a week, unless the affection has spread to the lungs and resulted in bronchitis —a frequent sequel—the patient, except for a free discharge from the nose, is practically well. In infants acute nasal catarrh is sometimes a dangerous malady, as it interferes with sleep, and, as they have to breathe through the mouth owing to the nasal obstruction, sucking is also interfered with.

Treatment.—Fresh air and cold baths are the great preventives of "catching cold." Sleeping with the windows open, taking a *tepid bath*, followed by a cold douche or sponge every morning summer and winter, and avoidance of all "coddling," will soon cure an individual of his predisposition to catching cold.

For the attack itself when severe the patient should be kept in bed, and a diaphoretic mixture such as the following administered every four hours: Sweet spirit of nitre, four drachms; liquor of the acetate of ammonia, two ounces; bicarbonate of potash, forty grains; ipecacuanha wine, forty drops; and camphor water to make the mixture up to eight ounces. Two tablespoonfuls to be given every four hours to an adult, whilst two teaspoonfuls may be given to a child. When the attack is accompanied by much aching of the limbs the following draught may be given to an adult at bedtime: *Salicylate* of soda, fifteen grains; sweet spirit of nitre, half a drachm; liquor of the acetate of ammonia, two drachms; and camphor water to make the draught up to two ounces. Instead of the above draught, ten grains of Dover's powder along with a hot drink may be given to an adult at bedtime. In the initial stages of the disease a few drops of the spirit of camphor taken on a lump of sugar is a popular remedy and often cuts short an attack, whilst warm baths, hot foot baths, and Turkish baths are very comforting. *Locally*, a four per cent. solution of cocaine inserted into the nostrils on a piece of cotton wool speedily relieves the obstruction, or one or other of the following forms of snuff may be tried: Hydrochlorate of morphia, two grains; bismuth subnitrate, six drachms; and powdered acacia, two drachms; or menthol, one part in ten parts of powdered boracic acid.

When the affection tends to become *chronic*, a change to the seaside or to a mountainous district, together with the administration of *quinine*, rapidly effects an improvement and finally a complete cure.

Chronic Nasal Catarrh.—Many cases of this disease are due to repeated attacks of the acute affection, which result in *thickening* of the lining membrane of the nose and consequent nasal obstruction, together with an alteration in the voice and impairment of the sense of smell and taste; and the *treatment* consists in attention to the general health, a change to the seaside, and if the nostrils are blocked with crusts, douching them with a solution of common salt and bicarbonate of soda, a teaspoonful of each to a pint of warm water. There is, however, another variety of the affection termed *ozæna* or *atrophic rhinitis*, in which the lining membrane of the nose becomes *wasted* or thinned, and in which greenish-coloured *crusts* form in the nostrils and give rise to the most *horrible odour*, which is, strange to say, not perceived by the patient himself. The *treatment* consists in the first instance in removing the crusts by douching the nostrils with a solution containing borax, ten grains; bicarbonate of soda, ten grains; and carbolic acid, two grains to the ounce of water, and afterwards by the systematic use of *antiseptics* to keep down the smell. The best results seem to have been obtained by adding a small teaspoonful of a fifty per cent. solution of aceto-tartrate of aluminium to a pint of water and using this as a douche; or two drachms of boracic acid may be added to a pint of water and used as a douche after the crusts have been removed. "Listerine" used as a spray is also recommended by some. The latest and most successful method of treating this troublesome affection, however, seems to be by *cupric electrolysis*, a form of electrical treatment which can of course only be carried out by an experienced surgeon.

Hay Fever.—This disease was first described by Bostock in 1819. It is widely prevalent during the months of May and June in the British Islands, whilst in America it does not make its appearance before the autumn. In America a similar affection is called "rose cold," and is due to the irritation produced by the pollen of the flowers.

Causes.—The irritating action of the *pollen* of plants, chiefly grasses, on the nasal mucous membrane. Certain *odours*, such as that of the *rose*. Emanations from certain animals, such as dogs, cats, and horses. Irritating particles of dust, salicylic acid, ipecacuanha, &c. *Heredity* plays an important part in the causation of the disease, as it is frequently found to run in families, and to pass from one generation to another. People of *nervous* or *rheumatic* constitution are peculiarly

susceptible to hay fever, and in most cases there is present an irritable condition of the nasal mucous membrane.

Symptoms.—These are very much the same as those of an ordinary cold in the head. There is nasal obstruction, sneezing, a copious serous discharge from the nostrils, itching and watering of the eyes; but in addition there may be attacks of paroxysmal *asthma* often indistinguishable from the ordinary bronchial form. Constitutional symptoms such as chilliness or a rise in the temperature are, however, as a rule absent.

Treatment.—This may be divided into *constitutional*, *climatic*, and *local*. As a rule *nerve tonics*, such as arsenic, strychnia, and phosphorus, are called for, whilst tepid baths followed by the *cold spray*, a proper amount of *exercise* in the open air, and plenty of fresh air indoors are also beneficial. People residing in towns derive great benefit from a change to the *seaside*, and, where practicable, a sea voyage during the months of May and June will ward off an attack. *Locally*, means must be taken to *harden* the nasal mucous membrane, and thus render it less irritable. It may be sprayed with a half per cent. solution of *protargol* or with a 1 in 5000, or 1 in 10,000 solution of *adrenalin chloride*, or a 10 to 20 per cent. solution of *menthol* in olive oil may be applied with a brush; and finally, should there be spots in the lining membrane of the nose, which are excessively irritable, these should be cauterised with the electric cautery.

Catarrh of the Larynx or **Laryngitis** may be acute or chronic. The *causes* of acute catarrh are very much the same as those of catarrh of the nasal passages; exposure to cold, more especially after a prolonged stay in a vitiated atmosphere, irritating particles of dust or vapours. Acute catarrh frequently accompanies the infective fevers, such as typhoid, smallpox, and measles, and a dangerous form is often caused in children by *burns* and *scalds*. The *chronic* variety of the complaint is frequently due to overstraining the voice, and is met with amongst public speakers and singers, whilst the habitual over-indulgence in tobacco smoking and alcohol also gives rise to it.

Symptoms.—These vary according to the severity of the attack and to the *age* of the patient. In *adults* the ordinary symptoms of a *common cold* are followed by *hoarseness*, an irritating tickling *cough*, and some difficulty in breathing, this last symptom sometimes assuming alarming characters when it is due to *spasm of the glottis*, or to a sudden swelling or *œdema* of the larynx, which is apt to occur when the patient is already a sufferer from chronic kidney disease or erysipelas. The *treatment* consists in confining the patient to the house, or to bed if the symptoms are severe, and in surrounding him with a warm moist atmosphere by means of the bronchitis kettle, or

by *inhalations* of medicated steam, a very soothing form of the latter being obtained by adding a teaspoonful of compound tincture of benzoin to a pint of hot water in a jug, and allowing the patient to inhale the steam. At short intervals the patient should also be given menthol pastilles to suck, and drinks of hot milk and seltzer water. For the relief of the cough warm poultices should be applied over the throat, and five grains of Dover's powders given every six hours.

In *young children* acute laryngitis is frequently met with, especially in those who have scrofulous constitutions, and are prone to catarrhal affections. The child is suffering from a common cold, and this is followed by *hoarseness*, which is always worse towards evening; there is also a *hoarse cough*, but little or no rise in the temperature, and the child, if carefully treated, usually gets well in a few days. If, however, the child is neglected, this catarrh gets worse, and *spasms of the glottis* occur which give rise to an alarming train of symptoms termed *false croup*. The child is put to bed to all appearance fairly well, and falls asleep. About midnight he wakens suddenly with a hoarse barking "croupy" cough; he suffers from great *difficulty of breathing*, and if the attack is a severe one, the face becomes livid, the nostrils work, and the eyes are staring and frightened-looking. The attack lasts from a minute or two to half-an-hour, and then as the spasm relaxes, the child gradually gets better and falls asleep again. There may be no more attacks till the following night, or the condition may get worse, and the child suffer from repeated attacks, both during the night and the day. During the attack the temperature generally rises to 102° F. or 103° F.

In cases which are due to a *scald* of the larynx, caused most frequently by attempting to drink water from the spout of a kettle which is standing on the hob, the child complains of severe *pain in the throat*, and refuses to swallow anything; there is, however, no difficulty in breathing to begin with, and he may fall asleep. In a few hours, however, the breathing becomes affected; it is rapid, noisy, and laboured. The lining membrane of the throat swells, and as the swelling increases the symptoms grow worse. The breathing becomes very difficult and croupy in character. The child grows very restless, his face becomes livid, and he may die in from 24 to 48 hours. If, however, the child can take nourishment and his strength holds out till such time as the swelling in the throat subsides, he may recover.

Treatment of acute laryngitis in children. In the *milder* cases, a hot bath, and confinement to one room, together with a diaphoretic mixture containing ipecacuanha wine ten drops, liquor of the acetate of ammonia twenty drops, glycerine ten drops, and water up to a

dessert-spoonful, given three or four times a day, usually effects a speedy cure. If the bowels are confined one or two grains of *calomel* should also be administered. In the *severe* forms accompanied by spasms of the glottis and attacks of difficult breathing, the child should be put immediately into a *warm bath*. After this *vomiting* should be procured by administering teaspoonful doses of ipecacuanha wine in warm water every ten minutes until the desired effect is produced, or if the child is a delicate one a teaspoonful of a solution of sulphate of copper, ten grains in two ounces of water, should be substituted for the ipecacuanha and given in the same way. Finally the child should be put to bed over which a tent has been erected, and the *steam* from a bronchitis kettle should play around him continuously. If the spasms are very frequent, two grains of *chloral* may be given three times a day to a child over two years of age. The child should be kept in bed as long as there is any fever, and the steam from the kettle continued until the hoarseness has disappeared. A preliminary dose of calomel, one or two grains, is also desirable.

In cases which are due to *scalding* of the throat, every effort must be made to support the child's strength, and, if he cannot swallow, food must be got into the stomach through a tube passed down through the nose. The best results seem to follow the administration of a grain of calomel every half-hour until green-coloured motions are passed. This treatment should be begun as soon as the accident happens, and before the difficulty of breathing has set in. In addition, of course, the child will be placed in bed, with the steam from a kettle playing round him; warm applications in the form of poultices or of sponges wrung out of hot water will be applied to the throat; he may have ice to suck, and be encouraged to swallow small quantities of *cream*, which will soothe the throat and nourish him as well. The services of a medical man must be obtained as quickly as possible, and no objection raised to the performance of the operation of tracheotomy, as in this often rests the one hope of saving the child's life.

Chronic Laryngitis may be the result of repeated acute attacks, of overtaxing the voice, as in speakers and singers—hence the name, "clergymen's sore throat"; or of the inflammation spreading from the back of the throat down to the larynx, as in heavy smokers and drunkards. Sometimes, and it is well to bear this in mind, this affection is a precursor of consumption or phthisis. The *symptoms* are hoarseness, which may be constant, or come on after the slightest exertion of the voice, a frequent desire to clear the throat, and expectoration.

The *treatment* consists in *resting* the voice, and avoiding cold and foggy atmosphere, and the two indications are most easily carried out

by a holiday away from home to such places as Ems, Mont Dore, &c. *Locally, inhalations* of medicated steam are recommended. Two drachms of pine oil and one drachm of light magnesia are added to three ounces of water. A teaspoonful of this mixture is added to a pint of water at 140° F. for each inhalation; or the throat may be *sprayed* with a solution of *tannin*, 2 to 10 grains to the ounce of water, or of *alum* of the same strength; and lastly, medicaments, such as solutions of nitrate of silver, may be painted on the larynx; but this can only be done by a physician.

Bronchitis.—This is an acute or chronic disease affecting the *bronchial tubes*, and consists in a catarrh or inflammation of their lining membrane. The acute form of this disease may confine itself to the large and medium-sized tubes, as is most frequently the case in adults; or it may attack the minute tubes and air vesicles of the lung, constituting capillary bronchitis or broncho-pneumonia, and this form is almost entirely confined to children.

Causes.—Bronchitis may arise from catching cold through exposure, or it may be *secondary* to such infective diseases as measles, whooping-cough, and scarlet fever; and lastly, it may be the result of chronic heart or kidney trouble. It is very common in damp localities.

Symptoms.—Acute bronchitis, when it attacks the *larger tubes*, commences with *pain* behind the breast bone; some rise in the temperature; a feeling of oppression in the chest; and a painful, hacking *cough*, which often comes in paroxysms. The *expectoration* is at first scanty, white, and frothy, but later on it becomes more copious and changes to a yellow colour, owing to the presence of pus cells. With the advent of free expectoration, the distressing symptoms are much relieved, the cough being not nearly so painful.

Acute bronchitis, affecting the minute tubes and air vesicles of the lungs, is termed *capillary bronchitis*, or broncho-pneumonia, and is always due to the invasion of the lungs by *microbes*. The disease may occur independently, when it is ushered in by a chill, or a *convulsion* occurring suddenly in a child who has been apparently quite well. There is a rapid rise in temperature, and the symptoms are very much the same as those of *pneumonia*, to be treated of later on. It is, however, far more frequently met with as a complication of, or secondary to, measles, whooping-cough, scarlet fever, or diphtheria. During the *convalescent* stage of these diseases, the child, more especially if he has been neglected and *exposed to a chill*, develops a *cough;* the temperature rises, and varies at different periods of the day. Gradually the breathing becomes rapid and difficult, the child is unable to cough up the expectoration, and his distress is thereby

greatly increased. The face turns livid, the eyes are staring and suffused, and the finger-nails turn blue. Soon the face assumes an anxious expression, and the child grows restless; then he becomes drowsy and apathetic, and eventually, as the fluid which he has no strength to cough up accumulates in his lungs, he is suffocated, and dies from paralysis of the heart.

The **Treatment** of cases where the large and medium sized tubes alone are affected consists in confining the patient to bed, giving him drinks of hot milk and seltzer-water, and applying warm linseed and mustard poultices to the back and chest. If the breathing is much oppressed the atmosphere of the room must be kept moist by a bronchitis kettle. In the case of adults, 5 grains of Dover's powder, given every six hours, often cuts short the attack; but opium in any form should not be given to very old or very young people. Whilst the cough is hard and painful a mixture such as the following may be given to an adult: Antimonial wine, 1 drachm; ipecacuanha wine, 1 drachm; compound tincture of camphor, 4 drachms; liquor of the acetate of ammonia, 3 ounces, and water to make the mixture up to 6 ounces. A tablespoonful of this to be given every four hours. To a child during the early stages a teaspoonful of the following mixture may be given every four hours: Ipecacuanha wine, 1 drachm; liquor of the acetate of ammonia, 4 drachms; glycerine, 2 drachms, and orange-flower water up to 2 ounces.

When the cough loosens and the expectoration becomes copious, a tablespoonful of the following mixture may be given every four hours to an adult: Chloride of ammonium, 72 grains; bicarbonate of soda, 48 grains; carbonate of ammonia, 24 grains; tincture of senega, 1½ drachms, and chloroform water to 6 ounces; whilst to a child a *teaspoonful* of the same mixture may be given.

In *capillary bronchitis*, which as has already been remarked occurs most frequently in *children*, the most important matter is to maintain the child's strength. The room in which the child lies should be warm, and the temperature should not be allowed to fall during the night and early morning. The atmosphere of the room must be kept moist with the bronchitis kettle. *Poultices* consisting of one part of mustard to six of linseed meal are to be applied alternately to the chest and back, drying the body carefully, and covering the chest and back with a sheet of wadding after the poultices have been removed. If the temperature is very high, *warm baths* not only bring it down for a while, but are also very soothing and refreshing to the little patient. The child's diet should consist of milk, eggs, and broth, and it is almost always necessary to give *brandy*, and this should never be omitted when the *pulse* shows

any tendency to failure; the best way to give it being in a mixture of white of egg and water, to which a little sugar has been added. Half a teaspoonful of brandy being given at a time to a child eighteen months old, and the effect on the pulse watched. As the child is always thirsty, he should be allowed sips of cold water frequently. Medicinally, a teaspoonful of the following mixture may be given every three hours, but medicine plays a small part in the treatment of this trouble: Bicarbonate of potash, 30 grains; aromatic spirit of ammonia, spirit of chloroform, and glycerine, of each 80 drops, and water to 2 ounces.

Chronic Bronchitis may be due to repeated acute attacks, but it occurs most frequently in persons suffering from heart or kidney disease. It constitutes the "winter cough" of old people, and is always worse during damp weather.

Symptoms.—Persons suffering from chronic bronchitis suffer from *shortness of breath;* more especially when making an effort, as when climbing up stairs. They have a *cough,* which is as a rule better in summer and worse in winter, and which sometimes comes on in paroxysms in the early morning, and at other times in the evening. The cough is accompanied by an abundant yellow *expectoration,* but this varies, and may sometimes be watery and frothy, and may also occasionally give off a very offensive odour.

Treatment.—Patients subject to chronic bronchitis should always wear woollen clothing, and avoid damp and chills. Residence in the south of France, or in some climate warmer and drier than that of the British Islands, during the winter and spring of the year, is the surest way of *avoiding* an attack. *Medicinally.*—A mixture containing chloride of ammonium and carbonate of ammonia, such as has been recommended for the later stages of acute bronchitis, gives much relief; or Begbie's mixture, containing dilute hydrocyanic acid, 30 drops; dilute nitric acid, 2 drachms; glycerine, 1 ounce; and infusion of quassia to 6 ounces, of which a tablespoonful is to be taken three times a day, will also be found useful. Pure terebene, four or five drops on a small lump of sugar taken three or four times a day often greatly relieves the stress of coughing. *Inhalations* of steam impregnated with eucalyptus, or with the compound tincture of benzoin, a teaspoonful to each pint of hot water, may be tried, or the throat may be *sprayed* with ipecacuanha wine. When the expectoration is of a disagreeable nature, a spray from a ten per cent. solution of carbolic acid will lessen the odour.

Bronchitis is a disease that is as a rule recovered from where the patients are strong young adults, but it frequently terminates fatally, and is always a dangerous affection at the two extremes

of life. Chronic bronchitis is rarely absolutely recovered from; there are always exacerbations more or less severe during each succeeding winter.

Bronchial Asthma.—This is a nervous disease of the bronchial tubes. According to some authorities it is due to *spasm* of the muscular fibres which are present in the tubes, whilst others again attribute the affection to a *congestion* and swelling of the mucous membrane; but as a matter of fact *both* causes are at work simultaneously, in some cases the spasmodic character being more in evidence, whilst in others the congestive or bronchitic is more prominent. The former class of cases are more frequently met with amongst *men*, whilst the latter prevail amongst women.

Causes.—Asthma is a disease which occurs very frequently in people of a *nervous* temperament. The first symptoms frequently make their appearance during childhood, and the starting-point in many cases may be dated from an attack of whooping-cough. *Heredity* undoubtedly is an important factor in the production of the disease, which often runs in families, especially in those who are the victims of *gout* in addition to being of nervous temperament. As gouty people often suffer from *eczema*, it follows that the skin complaint and asthma are frequently closely associated, and the children who suffer from eczema often develop asthma when they grow up, and indeed the two diseases are not infrequently present together. The *exciting causes* of an attack are very much the same as those of hay fever, which have already been mentioned. Thus peculiar *odours*, such as the emanations from cats, dogs, horses, particles of dust, the *pollen* of plants, give rise to attacks in some people, whilst certain localities affect others, and asthmatics generally exhibit the most peculiar idiosyncrasies as to their surroundings, some only being happy when their chimneys smoke, while others find that living in the vicinity of a stable affords them immunity from attacks. Overloading of the stomach, constipation and other alimentary disturbances, are frequently the exciting causes of an *attack*. And finally, the disease is often associated with affections of the *nose*, such as *polypi* and chronic nasal catarrh.

Symptoms.—Immediately prior to the actual attack, a patient often develops symptoms which experience has shown him are precursors of what is in store for him. He may be constipated, or his stomach and bowels may be distended with flatulence, or he may suffer from depression of spirits; and very soon after, generally between 2 A.M. and 6 A.M., the real asthmatic attacks are developed, and the patient starts from his sleep struggling for breath. And as the greatest difficulty lies in his getting air into his lungs—*inspiring*—the

holds on with both his hands to something firm to fix his arms and give purchase to his extraordinary muscles of respiration, and makes strong efforts to *inspire* air; his face is pale and the lips livid, his nostrils are working and the eyes are staring and suffused. A cold perspiration breaks out over the body, and the *pulse* is rapid and small. During such an attack the patient's whole energies are centred on the act of breathing, and he has time for nothing else, and speaking is quite out of the question. After a time, varying from a few minutes to an hour or more, the difficulty of breathing is lessened, and a dry cough, followed by the expectoration of whitish pellets of mucus, supervenes, which generally indicates a subsidence of the distressing symptoms, and as a rule the patient falls asleep. Such attacks may recur night after night for several nights, and then leave the patient absolutely free for months, but in the majority of cases, whilst the patient may be free from attacks during the day, some shortness of breath and wheezing remain, and in the long-standing cases *emphysema* results, and the patient suffers from *chronic bronchitis.*

Treatment.—This divides itself into the means to be adopted to ward off an attack, and those for the management of the attacks themselves. The most important point to consider in avoiding attacks is the *cause* of them. Once this has been discovered, their removal is a simple matter. Thus one of the most important causes is *locality,* and the large majority of cases are benefited by removal to *smoky* atmospheres such as that of London or Glasgow, whilst a few are the better of residing at the seaside. Then again *diet* has much to do with the onset of attacks, heavy suppers and late dinners often provoking them, whilst the partaking of such articles as cheese, nuts, stout, and wine often induce them in some people. The only *medicine* which seems to be of any use is iodide of potassium, and this should be given in from five to ten grain doses three times a day. For the attack itself there are many methods of treatment, all of them useful in one case or another. Some patients are immediately relieved by a hot cup of strong coffee, whilst others obtain the greatest benefit from a glass of hot whisky and water. To non-smokers inhaling the smoke of an ordinary cigarette often affords instant relief, the slight nausea which it produces relieving the breathing. Smoking the leaves of *stramonium* and swallowing the saliva is often useful. Filling the room with the white fumes produced by burning *nitre paper* affords the greatest relief to some patients; whilst the inhalation of the vapour of a few drops of *chloroform* helps others. Numerous brands of *asthma cigarettes* can be obtained, and the smoking of them affords relief to many, but undoubtedly the most rapid and lasting relief is

obtained from the hypodermic injection of *morphia.* This, however, should only be administered by a medical man, as the risk of becoming a slave to the habit is great, especially in the case of one who begins using the drug in ignorance of the deadly influence it may gain over him.

Emphysema.—This is a condition of the lungs in which the *alveoli*, the minute expansions of membrane in which the very smallest bronchi terminate, are *dilated,* the membranous walls become *atrophied*, and the capillary blood-vessels are obliterated, and this last results in obstruction to the circulation of the blood in the lungs, and consequently to dilatation of the right side of the heart, and to defective aeration of the blood. Many theories have been put forward from time to time to explain the condition of emphysema, but the one most widely accepted, and probably the right one, is that of Sir William Jenner, who said that the chest walls did not afford equable support to the lungs, and that whenever *expiration* was *obstructed* the *least supported areas* of the lung became *distended.* Now if this distension is repeated very frequently, it results in permanent *dilatation* of these areas of the lung, more especially if, as is supposed to be the case, the individual *inherits* lungs in which the elastic tissue is weak in type. Such repeated distensions occur in a disease like *bronchitis* where *cough* is a marked symptom. A cough is produced by *closure of the glottis,* followed by a sudden effort of expelling air from the lungs, and it follows therefore that emphysema is most frequently associated with bronchitis. But whilst coughing is the most frequent producer of emphysema, all operations in which one holds one's breath in order to fix the chest and give purchase to muscles which control other portions of the body, may also give rise to it, such as lifting or dragging heavy weights, playing wind instruments, &c. *Heredity* plays an important part in the production of the disease, many people suffering from a congenital defect in the elastic tissue of the lung, and hence it is that the condition so frequently begins during childhood.

Symptoms.—These as a rule begin *insidiously.* A child is unable to take part in the usual sports and games, because he gets *breathless* very soon. An adult experiences the same difficulty in climbing stairs. Later, this feeling of breathlessness becomes *permanent,* the patient has always an oppressive feeling in the chest, as if he were never able to empty it of a sufficient quantity of air; even speaking makes him breathless, and he has to stop more than once in the course of a sentence to draw a breath. The condition goes from bad to worse, till eventually the breathing becomes noisy. It is aggra-

vated by frequent attacks of *bronchitis* or spasmodic *asthma*. The patient has to be propped up with pillows at night, and as the obstruction to the circulation in the lungs begins to tell on the right side of the heart, and to cause *dilatation*, his face and hands, and sometimes his whole body become *livid*, and finally *dropsy* may result from the heart weakness. The change in the lungs causes a change in the *shape of the chest*, so that its diameter from front to back is greatly increased, the breastbone is prominent, and the ribs are wide apart. The back becomes rounded, and the whole chest becomes what has been described as "barrel-shaped." The progress of the condition is usually slow, depending, however, on the amount of care the patient can take of himself; but it is always from bad to worse, and eventually death occurs from some intercurrent acute disease such as *pneumonia*, or from *heart failure* due to over-distension of that organ.

Treatment.—While little can be done to actually remedy the condition, its progress may be greatly retarded by adopting suitable measures. Thus, as the greatest danger to the patient lies in repeated attacks of *bronchitis*, residence in an equable climate is of the utmost importance. This, together with regular gentle exercise, warm clothing, and avoidance of chills does much to stay the progress of the disease; whilst attention to the condition of the *stomach* and *bowels*, avoiding constipation and flatulent distension, are of almost equal importance. In the case of *children* the nose and throat should be carefully examined, and obstruction to breathing, such as *adenoid vegetations*, removed, if these are present. Medicines are not of much use, but the following prescription, which was Dr. Walshe's favourite, may be tried: Ætherial tincture of lobelia, 4 drachms; ipecacuanha wine, 1 drachm; syrup of squills, 4 drachms; compound tincture of benzoin, 6 drachms, and ammoniacum mixture up to 6 ounces. A tablespoonful to be given to an adult three times a day. For the dropsy, should this supervene, a pill containing half a grain of digitalis powder, 3 grains of the compound pill of squills, and 1 grain of blue pill given twice or thrice a day, quickly causes a free flow of urine, and relieves the distressing symptom.

Pleurodynia or "Chest Pain."—This is the name given to *rheumatism* affecting the muscles of the chest wall, and is mentioned here because of the frequency with which it is mistaken for *pleurisy*, the condition to be treated of next. It attacks the left side most frequently, and is accompanied by excruciating *pain* on coughing or drawing a deep breath; pain is also experienced on pressing the affected area. Pleurodynia may also be mistaken for intercostal neuralgia, and for the pain which precedes an attack of herpes zoster

or shingles. The *treatment* consists in applying a bandage firmly to the chest to restrict its movements, and also if the pain is very severe in poulticing the side. Internally a dose of opening medicine should be given to begin with, followed by salicylate of soda; ten-grain doses every three or four hours.

Pleurisy.—The pleura is a closed serous sac which completely covers the outer surface of the lungs, the inner surface of the chest wall, and the upper surface of the diaphragm, and renders these surfaces smooth; a small quantity of serous fluid is contained in the space between the lung and the chest wall. Pleurisy is an inflammation of the pleura. It may be acute or chronic, it may be *dry* or *moist*, and lastly, it may commence as an independent disease, or be secondary to some other affection. When the pleurisy is dry the smooth surface of the pleura becomes *roughened* by the deposit of fibrin, and on listening over the affected area the rough surfaces by rubbing against each other during the movements of breathing produce a sound of *friction* which can be easily heard. The inflammatory process may be arrested at this stage, and after a few days the two inflamed surfaces adhere to one another, and the friction sound can no longer be heard; but, on the other hand, the inflammation may become more intense and *serous fluid* may be poured out in addition to the fibrin and then again the friction sound will disappear because the roughened surfaces of the pleura are kept apart by the fluid. The lung is pressed away from the chest wall, and on listening, as there is a layer of *fluid* between the ear and the lung, the breath sounds cannot easily be heard; and lastly, if the forefinger of the left hand be placed firmly against the chest wall, and two or three sharp short taps be given it with the forefinger of the right hand (percussion) a dull *toneless* sound will be produced, quite different from the resonant note elicited by carrying out the same manœuvre over an unaffected area of the lung. At this stage again, the inflammatory process may, under treatment, be arrested, and the fluid be reabsorbed, when the friction sound may again be heard; or the inflammation may go a step further, and the serous fluid become *purulent*, when to all intents and purposes the pleural cavity, or a certain area of it, becomes converted into an *abscess* cavity, and the matter, if it is not let out by the physician, may "point" and burst out on the chest wall; or it may burst into the lung, when the patient would cough up pus; or it may burrow through the diaphragm and open into the abdomen.

Causes.—A large proportion of the cases of pleurisy are due to *tubercular* infection. It does not follow that every case of pleurisy must end in *consumption*, because it may remain *localised*, and not spread to the lung proper at all, or be cured before it has time to

spread to the lungs, just as tubercular affections of other organs such as *joints* and *glands* can be cured without the whole system becoming involved. But it behoves all who have inherited a weak resisting power against the attacks of the tubercle bacillus to remember that a *pain* in the side and a dry *cough* are often the first symptoms—frequently neglected—of consumption. *Dry* pleurisy may be the result of *exposure to cold*, though it is not commonly met with in people who are otherwise healthy as an independent or primary disease. Pleurisy as a *secondary* affection is always present in cases of *inflammation of the lungs*, the inflammation naturally spreading from the substance of the lung to its covering membrane; and it is the presence of the pleurisy which acounts for the pain in that disease. *Moist* pleurisy is in most cases of tubercular origin, but it may also be secondary to capillary bronchitis, or occur as a result of blood-poisoning. In cancer of the pleura the effusion contains blood.

Symptoms.—The onset of the disease may be *sudden*, the patient complaining of a sharp stabbing *pain* in the side; accompanying this is a short dry *cough*. The *temperature* rises, and the *pulse* quickens. The character of the *breathing* is altered, becoming much quicker and shallower, the patient doing all he can to prevent movement of the affected part of the chest, and sometimes supporting it with his hand to effect this. On *listening* over the affected area the *friction* sound can be heard. When effusion takes place the pain is lessened, but the breathing becomes more oppressed, the chest wall on the affected side moves less freely, and the dull note that has already been described can be elicited on *percussion*. If the effusion is a large one, adjacent organs are affected, the heart being pushed over to the right side, the lung itself is pressed down into a shrivelled-up solid mass, and the abdominal organs are pressed upon, and the ribs bulge outwards and are fixed. When the effusion becomes *purulent*, a *hectic flush* appears on the patient's cheeks, the temperature rises in an irregular manner, and the *pulse* becomes much quicker, the body is bathed in perspiration, and altogether the patient assumes a very unhealthy appearance. Sometimes the onset of pleurisy is very *insidious*, so that the real condition of affairs is not discovered until huge quantities of fluid have collected in the pleural cavity. The writer recalls one case, that of a woman, who came to him complaining of bloodlessness and of breathlessness, and asked for a tonic; the condition of her lips, which were *livid*, attracted his attention, and he found that her left pleural cavity was full of fluid, and subsequently he drew off a washhand basinful of fluid, much to the woman's surprise.

Treatment.—The patient must be kept in bed and put on

simple diet. The severe pain has to be relieved, and for this a few *leeches* applied to the painful area often do well; but better still is a hypodermic injection of *morphia*, which not only relieves the pain but also allays the cough. Hot fomentations and poultices are comforting. When fluid is poured into the pleural cavity efforts must, in the first instance, be made to encourage its reabsorption, and one of the ways of doing this is by depriving the blood of as much of its fluid constituents as possible, and thus compelling it to draw upon the pleural effusion to compensate itself for the loss. The liquids taken by the patient must be reduced to as small a quantity as possible, not exceeding eight to ten ounces of milk or water; this plan reduces the supply of fluid to the blood. Then, in the second place, the patient gets from half an ounce to an ounce and a half of *Epsom salts* every morning, or every other morning if he is not very strong, dissolved in as little water as possible, an hour before breakfast; this causes copious watery discharges from the bowels and depletes the blood of liquid. In this way many effusions rapidly disappear. The plan was introduced by Dr. Matthew Hay. Painting the chest with *iodine* and applying mustard plasters, or small fly-blisters, are also useful. If the effusion resists all these methods, or if it be very large, then it only remains to draw off the fluid by *aspiration*, which step of course can only be carried out by a medical man. *When the effusion becomes purulent the surgeon must be* called in, as the only way to treat the condition is by *free incision* into the chest wall; a portion of a rib having often to be removed to allow of free *drainage* of what is nothing but an abscess cavity, and the sooner the operation is performed after the condition has been recognised the more hopeful are the prospects of the patient's ultimate recovery.

Pneumonia or Inflammation of the Lungs.—*Inflammation* of the lungs is an acute *infectious* disease just as measles or diphtheria, and there is, as in all zymotic diseases, a general derangement of the system, together with a *local manifestation;* the latter in the case of pneumonia consisting in an inflammation of a greater or lesser portion of the lung substance. The disease is produced by the invasion of a *microbe*, the diplococcus of Fränkel and Weichselbaum; it is elliptical in shape and always occurs *in pairs*, hence the name "diplococcus." That the disease is an infectious one is proved by the fact that it runs a *definite course* as other infective fevers do; that the general symptoms are often out of all proportion in severity to the local manifestation, which points to infection of the whole system; and lastly, that frequently three and four people in the same house are attacked consecutively. The changes *in the lung* divide themselves

naturally into *three stages*. In the first, that of *congestion*, the minute blood-vessels ramifying in the walls of the air cells are engorged, the lining membrane of the air vesicles becomes swollen, and fluid is effused into the lung's substance. In the second, that of *red hepatisation*, corresponding to the period at which the fever is at its height, the inflamed portion of lung becomes *solid* like a bit of liver or beefsteak; it sinks in water, and is absolutely airless. In the third stage, that of *grey hepatisation*, corresponding to the period when the disease is abating and the temperature has fallen, the solid materials poured out into the lung becomes *softer*, leucocytes are present instead of red blood corpuscles, the colour of the affected area changes from reddish brown to greyish white, and the exudation is beginning to be absorbed.

Causes.—Exposure to *cold* has long been looked upon as the most frequent cause of inflammation of the lungs, the probability being, however, that cold merely reduces the power of resistance to the attack of the microbe. *Age* has an important bearing on the disease, children between the ages of two and six years being very prone to attack. It is very common in people over forty-five years of age, and is extremely fatal in those over sixty. Men are more frequently attacked than women, and *alcoholism* distinctly predisposes to the disease. It is met with most frequently during the winter and *spring* of the year.

Symptoms.—Pneumonia is always *sudden* in its onset, and most frequently begins with a *shivering fit* or chill in the case of an adult, whilst children often have a convulsion. There is a sense of chilliness in the back and of oppression in the chest. The *temperature* begins to rise almost immediately, and the *breathing* becomes rapid. The patient complains of *headache*, of being sore all over, and of a *pain* often situated in the region of the *nipple* or below the armpit. These early symptoms are quickly followed by a short dry *cough* which greatly intensifies the pain which is already present, and when the disease is fully established the patient lies in bed on his back, or on the affected side, with flushed cheeks, bright eyes, and nostrils working at each inspiration. The breathing is hurried, and the *pulse* full, bounding, and rapid; but in proportion to the increase in the pulse rate that of the breathing is much greater, so that whilst the pulse may be 120 or 130, the breathing may be 40 or 50 to the minute—that is, in the ratio of about 1 to 2 or 3 instead of 1 to 4 or 5, as is the case in health. The *temperature*, which rises rapidly, soon reaches 104° or 105°, and remains high until the stage of resolution commences (see Fig. 70). The cough is dry to begin with, but soon a viscid, tenacious, bloodstained *sputum* is

expectorated. It is quite red in colour at first, but soon assumes a *rusty* hue; it sticks to the patient's lips and teeth, and has to be wiped away frequently.

If the affected area be *percussed* in the manner described in the paragraph on pleurisy, a *dull note* will be elicited, but this will not have the "wooden" sound so characteristic of a pleuritic effusion; and on putting one's ear to the chest the breath sounds will be loud and distinctly heard, because the sounds produced in the larynx and trachea are readily transmitted through the portion of solid lung to the ear. At the beginning and end of the attack a sound such as can be produced by rubbing a few hairs between one's finger and thumb can also be distinguished; these are termed *crepitations*. The most characteristic feature of a typical attack of pneumonia is its manner of *resolution*, which is always by

FIG. 70.—Chart of Temperature in Pneumonia.

crisis; this rarely occurs earlier than the third day or later than the tenth. Most frequently on the fifth or *seventh* day the temperature begins to fall, and within twenty-four hours may drop from 104° or 105° to normal, or even below. The breathing becomes much slower, the pulse is *soft* and slow, the patient *perspires* freely, and drops into a refreshing *sleep*, having passed from a condition of much distress and even danger to one of comparative comfort. Whilst the above describes a fairly typical attack of pneumonia, the disease varies very much in the degrees of its severity, some cases being so mild that the physical signs alone indicate its presence, there being few or no symptoms; whilst others again are severe from the very first, the temperature rising rapidly to a great height, the pulse very rapid, and a large area of the lung affected, such cases usually terminating fatally on the third or fourth day of the attack.

Complications.—The most serious complication of pneumonia is *heart-failure.* The pulse, instead of being full and bounding, gets

soft and extremely rapid. The patient's face becomes ashy pale, his hands and feet are cold and clammy, and the whole body is covered with a cold perspiration. *Brain symptoms* frequently appear. Thus *headache* is almost always present; children frequently have convulsions. *Acute maniacal* symptoms are common, more especially in patients given to the abuse of alcohol, and such people are very apt to throw themselves out of the window if not carefully watched. *Pleurisy* is always present when the inflammation reaches the surface of the lung. *Rheumatism* in the joints is frequently met with. *Herpes* on the lips is frequently present, and is looked upon as a favourable sign. Finally, when all danger has apparently passed, the patient may die suddenly from *heart-failure* if he gets up too soon. Convalescence is as a rule, in the favourable cases, rapid; and within a week or ten days after the crisis all dulness and other signs of consolidation have disappeared; but sometimes the lung takes much longer to clear up, or fluid may have gathered in the pleural cavity, or an *abscess* may form in the lung substance, or the acute inflammation may pass into a *chronic* one, and terminate in *consumption*.

Treatment.—Anti-pneumococcic serum is said to reduce the attack to five days, otherwise it runs a definite course like all the other infective fevers, and treatment consists in guiding the patient through the rocks and shoals that lie ahead, combating untoward symptoms as they appear, and, above all things, paying close attention to the condition of the *heart*, and doing all in our power to ward off heart-failure. The patient should be placed in a large, well ventilated bedroom, and one into which as much *sunshine* as possible enters. He should be lightly, but warmly, clad in woollen clothes. His whole body should be sponged, limb by limb, with tepid water once every day, and his teeth and mouth should be kept scrupulously clean. The sputum should always be *burnt*, and not allowed to leave the room. Some antiseptic, such as eucalyptus oil, should constantly be evaporated in the room by means of a vaporiser. The *diet* should consist almost entirely of *milk*, with the addition occasionally of eggs, and one or other of the many patent foods. The patient should be allowed plain water to drink, also one or other of the table waters and lemonade. For the *pain*, hot linseed meal poultices, carefully made and constantly applied, are very comforting; but in many instances *ice* poultices, made by filling large, flat waterproof bags with crushed ice, and applying them to the affected area of the chest, with a layer of flannel intervening between the patient's skin and the bag, are even more soothing, and in addition they tend to lower the temperature a little, which is sometimes an advantage. When the

pain is very severe it may be necessary to inject *morphia* hypodermically.

To maintain the strength of the heart it may be *necessary to give stimulants,* and nothing suits better than *alcohol,* two to three ounces of which may be given to an adult in the twenty-four hours, always watching the effect, and reducing the quantity if the pulse gets too full and bounding, and increasing it if the dose fixed upon has no appreciable effect on a weak pulse. When the pulse, by its softness and rapidity, indicates *heart-failure,* energetic stimulation must be resorted to. If alcohol seems to strengthen the pulse, the dose must be steadily increased till 10 or 12 ounces, or even larger quantities, are given in the twenty-four hours. As regards drugs, *strychnia* is the most reliable, and of this 1-60th or 1-30th of a grain and even larger doses up to 1-15th of a grain, may be given every four hours. If [illegible] engorgement and embarrassment [illegible] of a few ounces of blood from one of the veins often gives instant relief. Other cardiac stimulants are carbonate of ammonia, better known in the form of its solution as sal volatile, chloric ether, and digitalis. When the *temperature* reaches a very high point, and remains there, steps must be taken to reduce it to some extent, more especially as a high temperature frequently conduces to heart-failure. All heart depressants, such as antipyrin, antimonial wine, &c., should be rigorously debarred, and resort made to sponging the body with tepid water, or [illegible] to the chest; or even, in desperate cases of *hyper-* [illegible] into a warm bath, which is rapidly [illegible]. The patient should not remain in the bath for more than ten minutes at a time. Of drugs for reducing the temperature, *quinine* seems the most reliable, and of this 10 grains may be given, and repeated again in an hour. When the patient is *sleepless* and restless, nothing does better than a draught containing 20 grains of chloral hydrate, 30 grains of bromide of potassium, and 2 drachms of the infusion of digitalis. When large areas of lung are affected, and little air can get to the blood, the inhalation of *oxygen gas* has been recommended, the idea being to introduce air in a concentrated form to the small portion of lung still able to do its work; but it is more than probable that the gas acts as an irritant, doing more harm than good. In America the serum mentioned above, given in a saline solution, is said to reduce pneumonia to two or three days. They also use optochin, a derivative of quinine. During convalescence the patient should have a full, nourishing diet, consisting of strong soups, milk puddings, and beef, according to the condition of his digestive system, whilst a little

sound wine is advantageous as a tonic to his appetite. He should be kept lying down in bed until such time as the heart has completely recovered its tone. Counter-irritation, in the form of painting with iodine, will help to clear up a consolidation which is long in disappearing.

Pulmonary Tuberculosis or Consumption.—A full account of tuberculosis, considered as a general infective fever, will be found in Vol. I. Here we have to do with its manifestations in the *lungs* alone, and in the limited space allotted to the subject little more can be attempted than an outline sketch of the clinical picture presented by the group of symptoms known as phthisis or *consumption.* The disease is due to the presence of the *tubercle bacillus,* which finds its way into the lungs either through the blood or through the *air passages.* Whichever be their means of entrance, on becoming implanted in the lung tissue they set up a low form of inflammation; scattered centres of inflammation or *tubercles* make their appearance in the lung tissue. Their component cell elements being of low vitality, they soon break down or *ulcerate,* and eventually *cavities* form in the lung, and in this way large portions of lung may be eaten away. As a consequence of the process of ulceration and the formation of *pus,* which is *septic,* the whole system becomes poisoned; and in the later stages of a case of consumption the symptoms of *blood-poisoning* are superadded to those due to the condition of the lungs.

Causes.—The primary cause of consumption of course is the tubercle bacillus or germ, but there are certain conditions which predispose people to their attack—provide a suitable soil, so to speak, for their growth and development. Of these *heredity* occupies an important position, for there can be no doubt that there are a great many people born with a resisting power weak against the attack of the bacillus, which is of course quite different from the old theory that children were born practically with the disease on them.

Occupation is another predisposing cause. Thus sempstresses and tailors, who lead sedentary lives—passing much of their time in badly ventilated rooms, and sitting in cramped positions—are frequently attacked; so are also those whose occupation leads to their inhaling particles of irritating dust—such as stone-masons, coal-miners, and flax-spinners. People who have an insufficient quantity of food, or whose digestive apparatus is weak, are prone to become phthisical. Certain *localities,* more especially those that are *damp,* and where the soil is *clay,* are notorious for the numerous cases of consumption that occur amongst the inhabitants. But of all the causes the most fruitful is residence in damp, ill-ventilated, sunless rooms. Sunshine

and fresh air are the deadliest enemies of the tubercle bacillus; darkness and impure air its firmest allies.

Mode of Onset.—This varies according to the *type* of the attack. In the *inflammatory* type the disease begins suddenly with a *chill* or shivering fit, and all the symptoms of *acute pneumonia* which have already been described, with this difference however, that when the time for the *crisis* comes round *none occurs;* instead the temperature becomes irregular, the patient suffers from night sweats, the *sputum* changes to a greenish colour, and on microscopical examination being made the tubercle bacillus is discovered. Such cases are very difficult to diagnose at the beginning, as they frequently occur in strong people enjoying apparently the best of health, and it is hard to believe that the case is not one of ordinary pneumonia; but the presence of the bacillus, and the early formation of cavities in the lung, remove all doubt. The patient may die in a few weeks, or the disease may become *chronic.* Or again, a child is convalescent from whooping-cough or measles, all seems to be going well, when suddenly the *temperature rises,* the child has a *cough,* and complains of shortness of breath. The symptoms are put down to *capillary bronchitis,* a sufficiently serious outlook in itself; but as time passes, the bronchitis refuses to clear up, the child *loses flesh,* the temperature takes on an *irregular* type, the patient wakens from sleep bathed in perspiration, and on examining the *sputum* the bacillus is found. Such inflammatory forms of the disease contribute largely to what are called cases of *galloping consumption,* the majority of the patients dying in a few weeks, though some of them may take on a chronic action. But the usual run of cases of consumption, or what is called chronic ulcerative phthisis, begin *insidiously;* they are tubercular from the very beginning, and the starting-point is usually in one or other *apex* of the lung—that is to say, in the portion that lies above and behind the *collar-bone.* In many cases so insidious has been its onset that it is already far advanced in the stage of cavity formation before it is discovered, and this is more commonly the case amongst working men, who probably have not much time to think of their own troubles, occupied as they are in the strenuous labour attendant on earning their daily bread.

Most frequently the disease begins as a *bronchitis.* The victim may have been subject to common colds, one of the attacks of which becomes chronic; and many cases of consumption are dated from the time when a "heavy cold settled down on the chest." Another symptom which is very frequently the first to call attention to the condition of the lung is *hæmoptysis,* or bleeding from the lung

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Mode of Onset.—This varies according to the *type* of the attack. In the *inflammatory* type the disease begins suddenly with a *chill* or shivering fit, and all the symptoms of *acute pneumonia* which have already been described, with this difference however, that when the time for the *crisis* comes round *none occurs;* instead the temperature becomes irregular, the patient suffers from night sweats, the *sputum* changes to a greenish colour, and on microscopical examination being made the tubercle bacillus is discovered. Such cases are very difficult to diagnose at the beginning, as they frequently occur in strong people enjoying apparently the best of health, and it is hard to believe that the case is not one of ordinary pneumonia; but the presence of the bacillus, and the early formation of cavities in the lung, remove all doubt. The patient may die in a few weeks, or the disease may become *chronic.* Or again, a child is convalescent from whooping-cough or measles, all seems to be going well, when suddenly the *temperature rises,* the child has a *cough,* and complains of shortness of breath. The symptoms are put down to *capillary bronchitis,* a sufficiently serious outlook in itself; but as time passes, the bronchitis refuses to clear up, the child *loses flesh,* the temperature takes on an *irregular* type, the patient wakens from sleep bathed in perspiration, and on examining the *sputum* the bacillus is found. Such inflammatory forms of the disease contribute largely to what are called cases of *galloping consumption,* the majority of the patients dying in a few weeks, though some of them may take on a chronic action. But the usual run of cases of consumption, or what is called chronic ulcerative phthisis, begin *insidiously;* they are tubercular from the very beginning, and the starting-point is usually in one or other *apex* of the lung—that is to say, in the portion that lies above and behind the *collar-bone.* In many cases so insidious has been its onset that it is already far advanced in the stage of cavity formation before it is discovered, and this is more commonly the case amongst working men, who probably have not much time to think of their own troubles, occupied as they are in the strenuous labour attendant on earning their daily bread.

Most frequently the disease begins as a *bronchitis.* The victim may have been subject to common colds, one of the attacks of which becomes chronic; and many cases of consumption are dated from the time when a "heavy cold settled down on the chest." Another symptom which is very frequently the first to call attention to the condition of the lung is *hæmoptysis,* or bleeding from the lung

the attack as a rule being absolutely sudden and unheralded, the patient tasting something warm and salty in his mouth, and discovering on spitting it out that it is pure fluid blood. Such a commencement is often a fortunate one for the patient, as it impresses him at once with the seriousness of his condition, and induces him to take energetic and frequently successful measures for its cure. The *glands in the neck* may have been scrofulous for months or years before the onset of tuberculosis in the lungs, the disease having in this instance been carried by the blood from the one site to the other; and it is in view of the undoubted risk of such a thing happening that surgeons so strongly urge the early removal of all glandular swellings that show an indication of breaking down and forming abscesses. Very many cases of consumption begin with symptoms of *indigestion*. The patient is disinclined for food, or the partaking of food gives rise to symptoms of dyspepsia, flatulent distension, and so on; he gradually becomes *bloodless*—anæmic—and in the case of women the monthly periods stop. As a result of the bloodlessness they suffer from *palpitation* and shortness of breath. One of the earliest symptoms in many cases is *pleurisy;* this may be of the *dry* form accompanied by pain and friction sounds, more especially over the apex of the lung. Or the disease may begin as an *effusion* into the pleural cavity. Lastly, *huskiness* of the voice, pointing to an affection of the throat, is sometimes the first indication of commencing phthisis.

Symptoms.—The earliest, and frequently the most persistent symptom of consumption is a *cough*, which at first is dry and harsh, but later, as the process of ulceration spreads, becomes much softer and is accompanied by a copious yellow *expectoration*. The cough is apt to occur in paroxysms, more especially in the early morning, and often leads to *vomiting*. The *expectoration*, which in the early stages presents no peculiarities, assumes the characteristic round flattened shape, which has led to its designation as *nummular*—coin shaped—when it comes from cavities in the lung. The individual pieces are greenish-grey in colour and sink to the bottom of the spitting cup. On preparing a cover glass specimen of a fragment of the sputum, and staining it in the manner to be presently described, minute, slightly curved, rod-like bodies will be seen under the microscope; these are tubercle bacilli, and their presence is an absolute proof of the nature of the disease.

Method of staining and mounting specimen of sputum: Two cover glasses are carefully washed in distilled water and absolute alcohol and then dried. A small piece of the sputum is placed on one of the cover glasses, and with the help of two clean needles is spread out over

this glass in as thin a film as possible; the remaining cover glass is then pressed firmly down on the film of sputum, so that when the glasses are separated each of them is covered with an exceedingly thin layer. One of the cover glasses is now grasped with a clean pair of forceps, and passed rapidly two or three times through the flame of a spirit lamp or bunsen burner—this dries it, and it is now ready for *staining*. Two solutions are needed for staining—*carbol fuchsin* and Löffler's methylene blue; these can be obtained from any chemist. About half a teaspoonful of the carbol fuchsin solution is poured into a clean watch-glass and brought to the boiling point over a spirit lamp. Next the cover glass with the film of sputum on it is floated on the hot fluid, preparation side downwards, for two minutes; it is then removed and washed alternately in water and in a 25 per cent. solution of *sulphuric acid* until the film is very faintly pink. Then the preparation is floated for one minute on some of the Löffler methylene blue solution in a watch-glass; it is then removed, washed in water and absolute alcohol, and dried in the air. To mount the specimen, a drop of Canada balsam is placed on a slide, and the cover glass, preparation side downwards, is carefully lowered on to the drop of balsam, and then pressed down on the slide, care being taken that no air bubbles form. On looking at the specimen under the microscope with a fairly high power lens, the bacilli will be seen as *pink rods*, whilst the surrounding tissues will be stained blue. This is known as the Ziehl-Neelson method, and is the simplest of the many in use.

In addition to the bacillus, fibres of *elastic* tissue are to be found in the sputum, a sure indication of the breaking down of lung substance. *Hæmoptysis*, or bleeding from the lung, is a common symptom, both at the very beginning, as has already been pointed out, and also during the course of the disease. When the symptom occurs early in the attack, the quantity of blood is as a rule small; it comes suddenly, is of a bright-red colour, and is mixed with froth. Death from hæmorrhage at this period is very rare, though the attacks are liable to recur frequently, and the sputum is stained with blood for some days after the attack has passed off. When bleeding occurs as a *late* symptom, it is usually due to the ulcerative process having eaten a hole into a large *artery* in the lung, or to the bursting of an *aneurism*, and the amount of blood is very large, often sufficient to cause death.

Pain in the chest is also a *frequent* symptom, more especially when pleurisy is present. Of the *general symptoms* the most prominent is a progressive wasting or *emaciation*; the patient steadily grows thinner and weaker, the loss of weight being an important

guide as to the progress of the disease. When it is arrested or quiescent the patient puts on flesh; when it is advancing he loses weight. *Fever* is another important symptom, and it varies in type. Thus sometimes it is *remittent* in character—that is to say there is a daily fall of a few degrees in the morning and a corresponding rise in the evening. At others it is *intermittent*, like the fever of malaria, where the patient has a daily shivering fit followed by a rapid rise in temperature, and this followed by profuse perspiration. When the cavities are large, and the patient is suffering from *blood-poisoning*, the temperature takes on the irregular *hectic* type so characteristic of that condition. Profuse *sweating* is one of the most trying symptoms of consumption, and it occurs most frequently in the early morning, or when the temperature begins to fall. The *skin* of a phthisical patient is usually dry and harsh, and brown scaly patches appear on the chest and brow; the *hair* is dry and "lanky," the nails are curved inwards and blue, and the ends of the fingers are broadened or "clubbed" in chronic cases. The *digestive system* is as a rule affected, the tongue being furred, the stomach often dilated, and *diarrhœa* being frequently severe and intractable. The *pulse* is as a rule rapid, and this is more especially the case when the fever is high. The heart is frequently dilated. In spite, however, of the fever, the sweating, the cough, the wasting, and the pain, "hope springs eternal" in the consumptive's breast, and the "spes phthisica" is at once the most marvellous and the most affecting of the symptoms of the disease. The fatal termination may be brought about by some intermittent attack such as that of *pneumonia*, or it may be due simply to a gradual failure of the strength; or again, it may be due to a *hæmorrhage* from the bursting of a large blood-vessel.

Treatment.—In the treatment of consumption there are three chief indications. In the first place we must place the patient amidst surroundings which are *congenial* and at the same time conducive to the maintenance of good health in the widest acceptance of the phrase; secondly, we must adopt the means which experience has shown are capable of retarding the growth of the tubercle bacillus; and thirdly, we must combat untoward *symptoms* as they arise. Now as to the first indication regarding *suitable surroundings*. Experiments have been made on animals—rabbits; a certain number were inoculated with the tubercular virus and kept shut up in coops in damp dark cellars. They all rapidly succumbed to the disease. Another set were inoculated and allowed to run wild; all or nearly all of them recovered, or had only very slight manifestations of the disease, and the same results follow with human beings. Patients allowed to run wild in the *open air* frequently recover, those shut up in dark, ill-ventilated

rooms *never do*; and this is the secret of the success of the *open-air treatment* which is now so much in vogue. Apart from the curative action of fresh air itself, another consequence of this treatment is that it *improves the appetite* and strengthens the digestive powers; and this after all is the chief factor in bringing the case to a successful issue, because the *digestive system* controls the whole situation. If a consumptive can be made to *grow fat*, he will soon cease to be a consumptive.

Open-Air Treatment.—The open-air treatment may be carried out at home or in a *sanatorium*. The advantages of residence in a sanatorium are that the patient is trained to be methodical. The advantages of fresh air morning, noon, and night, of *regular diet* and exercise, are impressed upon him; and for people of moderate means, to whom a prolonged residence in a sanatorium is impracticable on account of the expense, a three months' stay at one, followed by residence at home and a strict adherence to the plan of living adopted at "the San," is an admirable compromise and often followed by the best results. If the treatment has to be carried out *at home*, then a bedroom should be chosen which admits the maximum amount *of sunshine;* the windows should always be kept open, and if there are two windows one or other of them can be kept open, however blustery the wind may be. In fine weather the patient should pass the greater part of the day *out of doors*. When the patient's *temperature* is up, he should be in bed or resting on a couch, but fever does not contraindicate resting *out of doors* if the weather is fine. Should it be decided upon to send the patient *abroad*, to be the better able to carry out the open-air treatment, then a locality should be chosen where the air is pure, the temperature equable, and where there is a maximum amount of sunshine. Whether *a seaside health* resort or one in the mountains is chosen, should depend to a great extent on the tastes of the patient, but wherever the patient goes care must be taken that his home is a *comfortable* one and the *food good*. And because these two essentials are often difficult to obtain, treatment at home is often more satisfactory. Under no circumstances, however, should *advanced cases* be sent away; the change only adds to their discomforts, and the large majority of such cases never return. The *diet* of consumptives should consist largely of *milk* and eggs, butter and cream, but much will depend on the condition of the digestive system; nothing must be given which impairs this. And it is because *cod liver* oil has been given to all and sundry without considering its effects on the [illegible] is [illegible] repute of late. There we [illegible] or *preparation which* [illegible] of the many medicines

which are supposed to influence its course *arsenic* and *creosote* are the most reliable. The former may be given in the form of *Fowler's solution*, beginning with 2 or 3 drops in water three times a day after food, and gradually increasing it to 5 drops, always watching its effect on the *digestive system*, and discontinuing it when any symptoms of dyspepsia arise. *Creosote* may be given internally in the form of *capsules*, 1 drop in each capsule, gradually increased to 5 drops three times a day; or it may be given in the form of *inhalations*, 10 to 20 drops of the following preparation to be dropped on the sponge of a *respirator*, which is put on frequently in the course of the twenty-four hours, some patients indeed wearing them constantly. Rectified spirits of wine, 1 drachm; glycerine, 1 drachm; carbolic acid (pure), 2 drachms; creosote, 2 drachms; and proof spirit, 2 drachms.

Drugs.—Of the symptoms which need to be treated *fever* is one of the most important, and for this *rest* in bed indoors, or out of doors if possible, is essential. In addition, if the temperature mounts up very high, cold sponging and the tepid bath may also have to be resorted to. It is not well to restrict the *cough* to any great extent, but when it becomes very distressing or leads to vomiting the following —known as Begbie's mixture—may be tried, especially in advanced cases: Dilute hydrocyanic acid, 36 drops; dilute nitric acid, 2 drachms; glycerine, $1\frac{1}{2}$ oz.; and infusion of quassia up to 6 oz. A tablespoonful to be given in water three times a day, or a *teaspoonful* of the following mixture may be given occasionally through the day when the cough is very exhausting: Hydrochlorate of morphia, 1 grain; dilute hydrocyanic acid, 30 drops; dilute hydrochloric acid, 10 drops; syrup of squills, 1 oz.; and water, 1 oz. In addition, inhalations of compound tincture of benzoin, 10 to 20 drops for each inhalation may be tried, as also teaspoonfuls of *codeia* jelly occasionally; but it must always be borne in mind that a cough to get rid of the expectoration is an essential part of the disease, and that it must not be lightly interfered with. For the *sweating* cold sponging is very comforting, and to avoid the risk of *chills* patients should always be clothed in *flannel*. Of drugs, dilute sulphuric acid and quinine often prove useful, and 30 drops of the former and 2 grains of the latter dissolved in a tablespoonful of water may be given three times a day. Chronic cases which are too weak to be allowed out of bed are apt to develop *bed-sores*, and to avoid these the closest attention must be paid to *clean linen*, and the parts exposed to pressure must be washed two or three times a day with spirit, and then smeared with some simple ointment. Placing the patient on a *water bed* or an air cushion is a valuable prophylactic. *Hæmoptysis*, or bleeding, an important symptom, is treated under a separate

heading. It only remains to impress on the reader once more the fact that *drugs* play only a secondary part in our attack on consumption; *fresh air* and *sunshine* are our most reliable weapons, and maintaining the *nutrition* of the patient our goal.

Prevention.—A few words regarding the *prevention* of consumption may not be considered out of place. In the case of infants born of tubercular parents steps should be taken in this direction from the earliest possible moment; thus a consumptive mother should not suckle her child. Care should be taken to protect the child from *chills;* it should always wear woollen garments, and be out in the *open air* as much as possible. The diet should be carefully attended to, and should consist largely of milk. As it grows up systematic exercises with a view to developing the *chest* should be insisted upon, and any obstruction to breathing in the throat or nose such as enlarged tonsils or adenoid vegetations removed; and when the time comes for fixing on an occupation only such should be chosen as entail living out of doors for the greater part of the day, and where practicable emigration to a more equable climate such as that of South Africa should be advised. In the case of communities a close watch should be kept by the authorities on the *milk supply*, as there can be no doubt that milk is a fruitful source of infection, and that its effects are most severely felt by *children*, who are such large consumers. Further, the *notification* of cases of consumption should be compulsory, as is the case with most of the other infective fevers, for only thus can any systematic effort be made to stamp out the disease. Individuals who suffer from consumption should remember that the *sputum* is the most active agent in spreading the disease, and that the habit of spitting in cars, railway carriages, and on the pavement, whilst a filthy habit in itself, is a real danger to the healthy, and one which might easily be avoided by attention to the laws of ordinary decency and the use of a spitting cup or bottle.

Bleeding from the Lungs.—The spitting or coughing up of blood mixed with air which renders it frothy may be due to *congestion* of the blood-vessels which ramify in the mucous membrane of the air passages, in which case the blood is small in amount; or it may be due to the rupture of a large blood-vessel and the pouring out of its contents into the bronchial tubes, and in such cases the amount is very large, and the patient rarely recovers.

Causes.—Bleeding from the lungs has been mentioned as a frequent symptom in *consumption*, both in the early and later stages. It is frequently met with in disease of the *heart*, more especially when the mitral valve is affected, leading to engorgement of the blood-

vessels in the lungs. *Aneurism* of the *aorta* is another cause, and here there may be a considerable oozing of blood from the mucous membrane of the lung, or there may be a sudden overwhelming rush, which rapidly suffocates the patient. Ulceration of the *larynx* or windpipe frequently gives rise to severe hæmorrhage. Hysterical women sometimes have attacks of bleeding from the lungs when their menstruation ceases—this is termed *vicarious* hæmorrhage; and lastly, there are many cases in which there has been severe bleeding from the lungs for which no cause can be discovered, and which are followed by no further symptoms, the patient remaining perfectly well for years after the attack.

Symptoms.—The onset of bleeding from the lungs is as a rule *sudden.* The patient feels a warm salty fluid in his mouth, and discovers that it is blood; the amount is generally small, and the attack is accompanied by a *cough*, which is sometimes very distressing. Such cases as a rule recover within a few days; when, however, the blood comes from a ruptured *blood-vessel*, the amount is large, the bronchi soon become blocked with blood which the patient is too weak to cough up, and he quickly dies of suffocation. It is important to distinguish between blood that comes from the lungs and that which comes from the stomach. In the former case it is bright red in colour, is frothy from admixture with air, and is *alkaline* in reaction; in the latter it is dark in colour, often comes up in clots mingled with the contents of the stomach, and is acid in reaction. But it must be borne in mind that blood originally from the lungs may be swallowed and then vomited, and also that in such cases some of the swallowed blood passes into the intestine, rendering the stools dark for some days. The history of the case, too, is of some help, for when the blood has been vomited there have generally been some symptoms, such as pain and dyspepsia, pointing to a derangement of the stomach, whilst when it comes from the lung the onset is absolutely sudden.

Treatment.—One of the first things one is called upon to do is to *reassure* the patient; endeavour to calm him, and make him believe that such cases as a rule soon recover. Keep the room in which he is lying as *cool* as possible, and as quiet. If the affected side is known he should lie on it. For the cough nothing is better than *opium*—where the bleeding is slight—and it may be given in the form of *Dover's powder*, five grains every six hours; and to stop the bleeding he may have twenty to thirty drops of aromatic dilute sulphuric acid in water three or four times a day. Ice may also be given to suck, and an icebag placed over the affected area of the lung. If the pulse is hard and bounding, a dose of Epsom salts should be given, this acting better than anything else in *lowering the blood*

pressure, which is one of the indications of treatment. Small doses of tincture of aconite, a drop every quarter of an hour, may also be given with the same object. When the hæmorrhage is *severe* and evidently proceeding from a ruptured artery, very little can be done beyond keeping the patient very quiet, and applying ice to the chest. As *cough* plays an important part in keeping the bronchi clear of blood, and thus preventing suffocation, opium should *not* be given to restrain it. Alcohol, which is contra-indicated in cases of slight hæmorrhage, may have to be administered in small doses, and cautiously, to relieve the *faintness* from which the patient suffers, though faintness, it must be remembered, is nature's method of lowering the blood pressure and slowing the action of the heart.

Foreign Bodies in the Air-Passages.—There is no more alarming accident both to the sufferer and the onlooker than the inhaling of a foreign body into the *larynx*. Every one is familiar with the disagreeable sensation produced when a drop of water or some other fluid "goes down the wrong way"; but these sensations are intensified a thousandfold when some solid or semi-solid substance goes the same way, and a person who at one moment is in the best of health and spirits, may in the next be fighting madly for his very life. The substances which pass into the air-passages are of every conceivable nature—thus peas, beans, cherry stones, melon seeds, walnut shells, bits of hard-boiled egg, fragments of meat, buttons, pins, needles, coins, glass beads, artificial teeth, are only a few examples of the many which have accidentally passed into the air-passages and caused death. The foreign body may be caught and become fixed at the entrance to the *larynx*, or it may pass through and lie loose in the *trachea*; or lastly, it may become fixed in one or other of the *bronchi*, most frequently the right one. The *symptoms* produced by the entrance of a foreign body into the larynx come on with absolute *suddenness*. A child is playing and laughing, with something in his mouth, when suddenly the laugh is arrested, and immediately followed by a violent *cough*. The larynx is thrown into a spasm, and as a consequence, a sense of *suffocation* and of impending death overwhelms him. His face becomes livid, his eyeballs protrude, and he clutches desperately at his throat in a vain endeavour to remove the obstruction. Should the foreign body be large and have become impacted at the entrance to the larynx, and the patient be unable to dislodge it by coughing, he probably dies in a few seconds before any aid can be brought to him. If, however, respiration can still be carried on, the attacks after lasting from a few seconds to a few minutes, or even hours, may subside for a time, but only to be renewed on the slightest attempt at movement. When the foreign body passes beyond the

larynx and lies loose in the trachea, it can sometimes be heard moving up and down during respiration, and the slightest cough drives it up against the larynx and produces a renewal of the sense of suffocation, so that such patients always sit *straight up*, having learned by experience that any attempt at lying down brings back all the distressing symptoms.

Other Cases.—When the foreign body becomes impacted in a *bronchus*, or main division of the windpipe, there may be *no symptoms* for some time. Cases are on record where coins and bits of bone have lain in a bronchus for years without causing any discomfort, but as a rule in such cases inflammation of the lungs soon supervenes, and the patient dies of *septic pneumonia*. It is often very difficult to be sure of the pressure of a foreign body in the air passages, more especially when the symptoms have passed off quickly, and the patient, often a child, is unable to give a clear account of what happened. But it must never be forgotten that as long as the foreign body remains in the air-passages, not only is the patient in constant deadly peril of sudden death, but also that the foreign body is bound eventually to cause his death, unless indeed by some great good luck he coughs it up before the lungs have become hopelessly injured. The following case, which came under the writer's own notice, well illustrates the difficulty of locating a foreign body in the lungs. A woman was feeding her pigeons with peas. She carelessly threw one into her own mouth, and was immediately seized with a fit of coughing, and thought she was going to die. When the writer saw her, she was sitting up in bed afraid to speak lest the spasm should return. On sounding her chest, he thought he heard a flapping sound over the right lung, and came to the conclusion that the pea was lying loose in the right bronchus. He had her removed carefully to a hospital, where she was closely watched for a fortnight. She had an attack of catarrhal pneumonia, and her expectoration was tinged with blood. All preparations were made for performing *tracheotomy* should occasion arise, but as nothing happened, the surgeon came to the conclusion that the pea had never "gone down the wrong way," and as the woman grew tired of waiting for the *dénouement*, she decided on coming home. The road was a very rough causewayed one, the cab was not rubber-tired, consequently the jolting was considerable, and the woman had hardly gone a hundred yards from the hospital, when she had a terrific cough, felt something in her mouth, and discovered it was the pea, *which had begun to germinate*.

Treatment.—The *treatment* consists in performing *tracheotomy*, that is opening the trachea just below the larynx whenever the spasms

are so severe and so frequent that death seems imminent. Even when the patient is apparently dead, tracheotomy should be performed, and *artificial respiration* carried out in the hope of resuscitating him. The ordinary practice of thumping on the back does sometimes dislodge a foreign body lying loose, but no words can be too strong against the advice to *invert* a patient in the hope that the irritating substance will fall out. It is a most dangerous practice, which should *never* be resorted to. When the symptoms have lasted only a short time, and seem to have passed off, the patient should still be kept quiet, resting in the most comfortable position. He should be carefully watched, and some one should always be at hand to perform tracheotomy if necessary; and for this reason the safest plan is to send such a patient to hospital, where skilled attention is always to be had. Foreign bodies, such as beads, plum stones, marbles, &c., are frequently pushed into the *nostril* by children; and whenever it is noticed that there is obstruction to breathing through the nose, more especially when it is *one nostril only*, a foreign body should be suspected. The possibility of such an accident is often overlooked, and *ulceration* of the nostril frequently results, which is very unusual amongst children, except as a result of the impaction in it of a button or some such article.

The *treatment* consists in removing the foreign body, and this can as a rule be easily accomplished by bending a hairpin and passing it along the floor of the nostril under the foreign body and so extracting it. The nose may be *syringed* as directed in the section of this work devoted to foreign bodies in the nose (Ambulance Section).

SECTION VI

HYGIENE

The Principles and Practice of Hygiene.—The term *hygiene* may be regarded as synonymous with another, namely, *preventive medicine.* The first, derived from the Greek name of the "Goddess of Health," implies the knowledge and the practice of those laws according to which health may be duly preserved. The second phrase refers to the result of the observance and practice of health laws, namely, the *prevention of disease.* The knowledge that a large number of the diseases which afflict us are of preventable nature is of

comparatively recent growth, and depends for its origin upon the more accurate knowledge which has been gained respecting the causes of disease themselves. Whilst it is the business of the physician to cure disease, it may be regarded as everybody's business to prevent it, hence it is the object of the teaching of hygiene to instruct the people in the causes of disease, how these causes may be abolished or prevented, and how a healthy existence is only possible of being attained through the observance of health laws. When we awaken to a knowledge of the fact that our life is regulated by laws which, if incapable of being as methodically stated as, say, those of astronomy, are nevertheless capable of clear demonstration, it is obvious that not merely individual, but national, health would be largely increased if the observance of health conditions became a universal characteristic of the nation.

Cleanliness.—It may be said at the outset that the summing up of health laws and practice is to be found in the one word *cleanliness.* This phrase applies not merely to personal cleanliness, that is the removal of "dirt" from our clothes and our persons, but is extended to include purity of all our surroundings. The conditions for good health are readily enough summed up in the statement that in order to maintain a healthy existence we demand pure food, pure water, pure air, a cleanly soil on which our houses are built, perfect arrangements in the drainage of houses, conveying sewage matters far from our abodes, and cleanliness of our surroundings at large. In the practice of modern surgery, as most readers are aware, the strictest attention is paid to the exclusion from wounds of all forms of germ life, which, gaining admittance to the body, produce inflammation, suppuration, and other disastrous effects. The modern surgeon is nothing if he is not cleanly, not merely in his person but in all his methods, this care extending, it need hardly be said, to the instruments he uses. What is true of the surgeon is also true of our ordinary life and surroundings. If our food, water, air, or any other items in our environment be of an uncleanly description we are certain to qualify for disease attack. Bearing this important fact in mind we may note throughout the discussion of hygienic details that the aim and end of all the precepts of health science are devoted to favour and secure "cleanliness" of ourselves and every detail of life.

Preventable Disease.—An important thought in connection with the practice of hygiene is that involved in the statement that many diseases are preventable. Were this not the case our attempts to prevent ailments would be of no avail. It may be said that the vast majority of diseases which largely contribute to the yearly

mortality of all nations are exactly those which through the exercise of proper care and supervision can be held in check. This power of preventing disease, as has already been remarked, appears as the natural outcome of a knowledge of the *causes of disease,* a subject fully treated in the first volume of the work. It was the discovery of the germ theory (see vol. iv.), and its applications to medical practice, which gave an immense impetus to the practice of disease prevention. If we know, for example, that each case of infectious disease is the child and offspring of a preceding case, and that no case of infection can possibly arise without the presence of the germ of the ailment, it is clear such a teaching impressed upon the people would have the needful effect (if the teaching were carried into practice) of making them intensely careful of the first cases of infectious disease which appeared in their midst. By checking these cases, and by early separating and isolating them from healthy persons, epidemics could in this way be largely prevented.

Causes of Disease.—A brief enumeration of the common causes of disease, viewed from the standpoint of hygiene, may suffice in the present instance. Disease can thus be produced by *impure or polluted water* (typhoid fever and dysentery), by *impure or unsuitable food* (scurvy, parasites), by *impure air* (typhus fever, consump- [illegible] *unhealthy houses* [illegible] *direct infection* [illegible] *casualties* (cases suitable for ambulance treatment), and finally by the action of *heredity or inheritance.* This latter cause of disease is in many senses an extremely complicated one. There can be little doubt that a parent has power to hand on certain diseases to his offspring. Of these gout, syphilis, and scrofula may be regarded as examples. Much, however, can be done by the hygienic care of children in such case to enable them to grow up into healthy adults. Certain diseases formerly regarded as being inherited (consumption being an excellent example) are now known to present us with cases of individual infection. It may be said as regards the question of heredity at large, that whilst certain ailments, as we have seen, can be handed on from parent to offspring, what is much more likely to be transmitted in many cases is not the actual disease itself, but a general weakly condition of body, rendering the child more susceptible of developing the parental disease than is the offspring of healthy parents.

FOODS

Food represents material derived from the outer world required not merely for the growth of the body itself, but also for the repair of its tissues, and for replacing the constant wear and tear which in a living body is the result of the work that body is perpetually discharging. When we have regard to the large amount of "energy" which a living body develops and dissipates, in the act not merely of maintaining its bodily heat, but also in movement and in all other actions taking place within its limits, we can understand the necessity for food taking. If all vital work means waste, such waste demands more or less constant repair, and our food supplies the material by means of which this bodily wear and tear are recuperated.

If we analyse out into their ultimate constituents the foods upon which we exist we may find the following table to indicate the more prominent items in our diet-list.

Table of Foods.

1. Nitrogenous or Albuminous Foods or Proteids	Albumen (in white of egg), Myosin (in muscle juice), Syntonin (in the fibres of muscle), Fibrin (in blood), Casein (in milk), Gluten (in flour), Legumin (in peas, beans, and lentils), Globulin (in blood corpuscles), Gelatin (in hoofs, horns, and bones), Ossein (in bones), Chondrin (in cartilage).
2. Non-Nitrogenous Foods.	(*a*) Carbohydrates (starches and sugars:—Starch, Dextrin, Cane sugar, Grape sugar, Milk sugar, &c. (*b*) Fats:—Olein, Stearin, Palmitin. (*c*) Minerals:—Iron, the various compounds of soda, potash, lime, magnesia, &c. (*d*) Water. [Certain vegetable acids, represented by tartaric, citric, malic, acetic, and like acids are sometimes included amongst the starches and sugars.]

In considering this table of foods, it is necessary first to note clearly the marked differences which exist between the *nitrogenous foods* on the one hand and *non-nitrogenous foods* on the other. "Nitrogenous" foods are so-called because, in addition to their containing carbon, hydrogen, and oxygen (with traces of sulphur and phosphorus), they also contain a certain proportion of the element *nitrogen*. It should be noted that the presence or absence of this element constitutes a very important difference between these two

classes of foods. We find that nitrogen is an element present in protoplasm or living matter itself, and in all the active tissues of the body. A food, therefore, containing this element is adapted to discharge in the economy very different functions from the non-nitrogenous foods. The "non-nitrogenous" foods, on the other hand, exhibit a composition in which nitrogen is found to be wanting. The fats are specially rich in carbon, and in addition consist of hydrogen and oxygen in certain proportions. The starches and sugars—these substances being closely allied to each other, and all starch being converted into sugar in the body in the course of digestion—are also composed of carbon, hydrogen, and oxygen, but they contain less carbon, and the proportions of hydrogen and oxygen present are those which are represented in the form of water. Hence the origin of the name "carbohydrate" which has been applied to them. With reference to the *minerals* required as elements in our food, each of these of course presents its own definite composition, whilst *water*, which may be regarded as the most important food of all in respect of the necessity of a large and constant supply being afforded to the body, is composed of two gases—hydrogen and oxygen, the chemical symbol for water being H_2O.

Reference has been duly made in section 1 of the second volume of this work to the chemical composition of the body. It was there shown that a striking and natural likeness exists between the materials of which the body is composed and the substances found in the frame itself. Reference may therefore be made to the section in question by way of further impressing upon the mind the essential identity between the body's composition and the substances necessary for its due nutrition.

Uses of Foods.—The duties which these food substances discharge in the nutrition of the body may next be noted. A clear idea of the difference between one kind of food and another may be conveyed if we compare the body to a locomotive engine. In the first instance the engine must be built and constructed of a certain kind of material, let us suppose iron. In order, however, that the engine may duly perform the duties it is intended to discharge, we have to supply it with material out of which can be developed its "energy" or "the power of doing work." These materials in the case of the engine are represented by coal and water. If we now compare the living body to the engine, we find a close resemblance between the two. In the first place our bodies require to be built. Further, their living substance demands constant maintenance. Like the engine also, the body requires to be supplied with material in the shape of foods out of which may be developed its own forms of energy,

giving it the power of performing the duties it is called upon to discharge. The *nitrogenous foods*, broadly regarded, are those which represent the materials of the engine. They go to build up the living tissues of the frame, and represent practically therefore our iron and steel. Their nearness in composition to the living matter of the body itself presents them naturally as the source of supply for the living tissues. In addition, however, they may under certain circumstances contribute to the development of energy or power in the body, for we know that they may be converted into fat under certain circumstances. Here it is important to remark that whilst these facts are true of nitrogenous substances or proteids at large, such substances as gelatin, ossein, and chondrin do not hold the same rank as albumen and other more typically nitrogenous foods. Certain principles known as *extractives*, representing the stimulating parts, for example, of meat, also fall to be included in the nitrogenous foods, and although they do not assist in the work of body building, they are nevertheless important as stimulants.

Non-Nitrogenous Foods.—Turning now to the non-nitrogenous foods we find that the fats, starches, and sugars may be regarded as our great *energy producers*, and are therefore to be compared to the coal and water of the engine. Fats, for example, aid in supplying those parts of the body where fat is naturally developed and required. They also, on account of the large amount of carbon they contain, supply energy and heat when they are oxidised or chemically burned in the body. Starches and sugars discharge essentially the same duties in the body as the fats. They supply energy and heat, whilst they also contribute (as was shown in the first volume of this book in the section on *Obesity*) under certain circumstances and especially when taken in excess to the development of fat. The vegetable acids noted in the table of foods, and represented by tartaric and citric acids, are necessary for the preservation of the alkaline nature of the blood. When they are deficient *Scurvy* (vol. i.) breaks out.

Our Mineral Foods.—The *minerals* in our foods are applied to various uses. Iron is required in order to perfect the red corpuscles of the blood and to fit them for discharging their special duties. Phosphate of lime is demanded for building the bones. Common salt (*chloride of sodium*) is also a necessary mineral, being apparently required for the perfection of the gastric juice of the stomach whilst it discharges other functions in the body. Finally *water*, which as we have seen is the most important food of all, derives its importance from the fact that the body by weight consists of two-thirds of water. It is demanded for the solution of other foods, and it may be added that there is no vital action carried

on in the living frame in which water does not play an important part. Considering also that a perpetual loss of water is taking place from skin, lungs, and kidneys in the act of excretion (or getting rid of bodily waste), we may readily understand the necessity for a constant renewal of our supply.

The Laws of Nutrition.—Seeing that both classes of foods are represented in the structure of the body, and are required for the body's wants, the first rule which must guide us in the selection and choice of foods is that which declares that *both classes of food are necessary to form a perfect dietary.* We cannot subsist on nitrogenous foods alone, or on non-nitrogenous foods only. Examples derived from nature herself may illustrate this point. *Milk*, which is the natural food of the young quadruped, consists of water, minerals, casein, fat, and sugar of milk. All of these, except the casein, represent non-nitrogenous substances, but milk is clearly seen here to present a combination of the two classes. Similarly, *an egg*, which contains all the materials necessary for building the body of the bird, is found to be composed of nitrogenous and non-nitrogenous substances. With regard to the source of man's foods, these are represented by animal matter alone, by vegetable matter alone, and by a combination of the two, or in other words by a *mixed dietary.* The great law which regulates the food of any nation is that which declares that a nation's diet *depends on climate.* In the extreme north man is an animal feeder, and lives largely on fats. It would be impossible for him in, say, the Arctic regions to obtain the necessary heat from vegetable matters, even if he were abundantly provided with them. In the extreme south, man is naturally a vegetable feeder, finding fruits and other plant foods ready to hand. In temperate climates he inclines to the mixed mode of feeding, taking a certain proportion of animal food, but largely supplementing this with vegetable matters in the shape of bread, rice, tapioca, fruits, and green vegetables. The consideration of this great climatic law of food successfully disposes of the pretensions of vegetarians and other would-be food reformers. It is undeniable that many individuals may in a temperate climate enjoy better health on a purely vegetarian dietary, than on one which includes a certain amount of meat, but these cases present exceptions to the general rule, and in such cases it will be found that those who benefit from the meagre dietary represented by vegetable material are persons of a full habit of body, who incline to make much blood, so to speak, on little food. After all, nature is our best teacher, and the fact that man can accommodate himself to live upon those food matters which lie readiest to his hand, successfully disposes of attempts to overrule the natural

law by the adoption of a dietary which, whilst adapted for some, cannot possibly be regarded as suitable for all. The following table gives, as nearly as possible, the percentage composition of the more common articles of food in daily use. The table itself can be easily understood if we note that the first column indicates the amount of water chemically contained in each food, the second column the amount of the nitrogenous substances, the third column the fats, the fourth the starches and sugars, and the fifth the minerals :—

PERCENTAGE COMPOSITION OF FOODS

Food.	Water.	Nitrogenous Matter.	Fat.	Starch and Sugar.	Minerals.
Butcher meat	74.4	20.5	3.5	—	1.6
Fat pork	39.0	9.8	48.9	—	2.3
White fish	78.0	18.1	2.4	—	1.0
Poultry	74.0	21.0	3.8	—	1.2
White bread	40.0	8.0	1.5	49.2	1.3
Rice	10.0	5.0	0.8	83.2	0.5
Oatmeal	15.0	12.6	5.6	63.0	3.0
Arrowroot	15.4	0.8	—	83.3	0.27
Potatoes	74.0	2.0	0.16	21.0	1.0
Dry peas	15.0	22.0	2.0	53.0	2.4
Carrots	85.0	1.6	0.25	8.4	1.0
Cabbage	91.0	1.8	0.5	5.8	0.7
Egg	73.5	13.5	11.6	—	1.0
Cheese	36.8	33.5	24.3	—	5.4
Milk	86.8	4.0	3.7	4.8	0.7
Sugar	3.0	—	—	96.5	0.5

Quantities of Foods Required.—The question of the quantity of food required for the support of the human body daily, is one which can only be determined perfectly by the consideration of conditions represented by age, sex, the condition of health, and the amount of work performed by the body. According to the most recent views expressed as the result of numerous experiments, an adult man requires for his daily dietary *in a state of rest*, 3 oz. of nitrogenous food, 1½ oz. of fat, 12 oz. of carbohydrates, and 1 oz. of minerals, these amounts containing 200 grains of nitrogen and 4000 grains of carbon. It must be noted that as regards these calculations the food is regarded as being free from water, which is chemically and naturally combined with it. In a case of moderate work, the adult man will demand 4½ oz. of nitrogenous foods, 3 oz. of fat, 15 oz. of starches and sugars, and 1¼ oz. of minerals. These amounts represent 300 grains of nitrogen and 5000 grains of carbon. In the case of

an individual doing hard work, the amounts are increased to 6 oz. of nitrogenous foods, 4½ oz. of fat, 18 oz. of carbohydrates, and 1½ oz. of minerals. These latter quantities represent 400 grains of pure nitrogen, and 6000 grains of carbon. It will be understood, as a matter of fact, that the amounts of actual food taken would be larger than the quantities here represented, seeing that the calculations refer to actual food passing into the blood, and being placed at the service of the body, no allowance for waste being made. It is also to be noted that in addition to the water which would be contained in foods taken in their natural state, the individual would additionally require in the form of his ordinary beverages from 50 oz. to 80 oz. of water daily. The amount of water represented in the solid foods themselves would amount to about 40 oz. to 50 oz. In this way the individual consumes daily about one-hundredth part of his weight of dry food, and three-hundredths of water. Women, on an average, require ten per cent. less than men of each class of foods, nitrogenous and non-nitrogenous. In the case of infants, a greater demand exists for nitrogenous foods for body building, along with fatty foods. In their case a small supply of carbohydrates is alone required, these being supplied by the sugar of milk. It is estimated that at ten years of age a child requires half the food of an adult woman, whilst at fourteen years of age he probably consumes as much as the adult female.

Economy in Diet.—The principles of economy must certainly be represented in diet as they must figure in the ordinary affairs of life. It is obvious that if a large amount of any particular food or foods is taken than is necessary for the purposes of the body, such excess not merely represents actual waste but may be liable in many cases to induce disease. A familiar illustration has been given of a dietary which is economical and others which are the reverse in the shape of a calculation, which takes as its basis that an adult man requires 300 grains of nitrogen and say 4800 grains of carbon (or non-nitrogenous food) per day. Such an amount would be contained in three-quarters of a pound of meat and two pounds of bread. Suppose, on the other hand, that beef alone were given for the day's dietary, 2¾ lbs. would be required. This amount would, however, give a gross excess of nitrogenous food, yet the amount could not be limited because just sufficient carbon (from the fat of the meat) would be supplied. On the other hand, 3¾ lbs. of bread would be required for the food per day if that article alone was consumed. Here we should meet with the opposite result to that seen in the taking of the meat diet, for bread alone would give us a large excess of carbon in the shape of its starch. The amount, however

again, could not be limited seeing that $3\frac{1}{8}$ lbs. of bread would be needed to give (from the gluten contained in it) the bare 300 grains of nitrogen required.

The Calculation of Food Elements.—Having regard to the amount of substances shown in our table of foods, it is a comparatively simple matter to calculate the amounts of these materials contained in any given combination of substances forming a dietary. A typical illustration is given by an authority in the case of a diet comprised of two pounds of bread and half a pound of cheese. Taking the percentage composition of bread, we find that 100 ounces of bread contain about 8 ounces of nitrogenous matter, $1\frac{1}{2}$ ounces of fat, and 50 ounces of starch and sugar. In the same proportion 2 lbs. of bread will contain 2.5 oz. of nitrogenous matter, 0.5 of fat, and 16 oz. of starch and sugar constituents. With regard to cheese, 100 oz. of cheese contain 33 oz. of nitrogenous matter, and 24 oz. of fat, starch and sugar being absent. The half pound of cheese will therefore be represented by 2.6 oz. of nitrogenous matter, 1.9 oz. of fat, and 0.0 oz. of carbohydrates. The detailed amounts from the combination of the two foods will give us 5 oz. of nitrogenous food, 2.4 oz. of fat, and 16 oz. of starch and sugar. We have seen that the typical amounts required for moderate work are $4\frac{1}{2}$ oz. of nitrogenous foods, 3 oz. of fat, and 15 oz. of starches and sugars. Hence a dietary of bread and cheese would give us sufficient nitrogenous matter and starches and sugars, but would exhibit a slight falling off in the amount of fat.

Food and Disease.—Little need be said in this place concerning the relations of food and disease. In other sections of this work devoted to the consideration of disease and its treatment, full reference will be found (as in the case of scurvy) to those diseases which specially owe their origin to abnormalities in the food-supply; also, with regard to foods which in consequence of the presence of animal parasites are to be regarded as dangerous, this topic will be found treated under the head of "Parasites" (vol. ii.). It is necessary, however, here to direct attention to the fact that certain foods, and especially flesh foods and fish, are liable to undergo processes of putrefaction and decomposition, resulting in the development in them of highly injurious and poisonous principles to which the name of *ptomaines* is given. It is highly probable that most, if not all, reported cases of so-called "food poisoning" are due to the action of these subtle poisons on the body. They are capable of producing vomiting, purging, headache, pain in the abdomen, and in severe cases collapse and death. The presence of these poisonous principles is not always easy to detect, and they may apparently be

developed in foods which to the ordinary senses appear perfectly sound. The only rules which can be recommended for the avoidance of food-poisoning are those which once again impress upon us the necessity for exercising the great virtue of cleanliness. All foods should be kept in clean well-ventilated places, removed from the influence especially of sinks and drains. Those foods which appear most liable to undergo decomposition in a rapid fashion when exposed to injurious influences are fish, pork, hams, and rabbit. In the case of tinned foods, the advice may be given that when once opened they should be consumed as quickly as possible, whilst the consumption of the layer of food next the tin should be avoided. With reference to the characters of wholesome meat, the tissue of the meat should be firm and of an elastic nature. Any watery appearance of the meat should convey the suspicion that it is not of a healthy character. The meat should be red throughout its substance, any alteration of colour in this respect being indicative of injurious changes. No other fluid should exude from it than ordinary thin red blood, whilst the smell should be that of healthy meat. It is advisable where meat is suspected of having undergone injurious changes that the clean blade of a long knife should be passed deeply into the substance of the meat, allowed to remain for a short period, and then withdrawn. If the blade is found to exhibit any disagreeable odour, the meat should be condemned. This test is of importance, because occasionally meat may be decomposing in the centre whilst its outer parts may appear of a fresh character, especially after it has been cooked.

OUR BEVERAGES

The beverages in common use are represented by *water, tea, coffee, cocoa*, and various forms of *alcoholic liquors*, while aerated waters and mineral waters may of course be added to this list. The question of *water supply* will be discussed hereafter. In the present instance it is necessary to deal with the other beverages above named. The general opinion that tea and coffee represent foods is an entirely mistaken one. They are purely stimulants, and nothing else. Having regard to this fact, we see how lamentable is the delusion which leads those who have little money to spend on food to rely upon tea and coffee as nutritive substances. A large proportion of the digestive ailments, and likewise of cases of under-nutrition seen in the masses of the country, depends on the abuse of these beverages. Tea obtained from the leaf of the tea-plant contains practically nothing in the way of nutritious substances. It however contains a certain [illegible]

theine which is the active principle of the tea-leaf, and which gives to the beverage its stimulating qualities. In coffee we find a similar substance, known as *caffein*, which is probably more distinctly a nerve-stimulant than the theine of tea.

About Cocoa.—These beverages, in addition to their stimulating properties, appear to exercise a certain action limiting the bodily waste. It is probable that they accomplish this effect through some action or other tending to limit what is called the metabolism of food, or, in other words, those changes through which food ultimately becomes utilised in the body. With regard to *cocoa*, this substance in its nature is highly different from tea. *Cocoa is a true food.* Its composition exhibits a high percentage of nitrogenous substances, and a very large quantity of fat, along with a fair amount of starch. It can thus be seen that cocoa contains actual food materials, whereas tea and coffee do not. If the masses, from the point of view of economy, could only be persuaded to replace tea and coffee by cocoa, they would obtain a large amount of nourishment at a price under that paid for tea and coffee, which, we have seen, are not foods at all. It is of importance that the reader should be warned against the adulterations of cocoa commonly practised. Such adulteration consists frequently in the addition to cocoa of undesirable substances which are erroneously believed to increase its nutritive action. Pure cocoa is in itself a natural food, and requires no addition whatever. English-made cocoas are much superior to all others, and there is no better or more nutritious brand than that known as the Pure Concentrated Cocoa, made by Messrs. Fry of Bristol.

Alcohol.—The question of the power and place of alcohol, viewed scientifically, is an extremely wide one. The quantity of alcohol contained in various beverages varies from 50 per cent. in the case of stronger liquors, such as gin, rum, and whisky, to 10 per cent. in such wines as clarets, and downwards to 5 per cent., or less, in beers. We must therefore guard against the popular notion that when a person drinks a certain amount of a beverage containing alcohol he is consuming that amount of *absolute alcohol*. A large amount of discussion has existed in physiological circles as to whether alcohol is to be regarded as a food or not; that is to say, whether or not it contains elements which can be utilised for the body's support, or whether, on the other hand, like tea and coffee, it merely exercises a certain stimulant action, apart altogether from playing any part in nutrition. Recent experiments would appear to substantiate the idea that alcohol may be physiologically considered as a food, but this expression must be translated freely into the opinion that it is a food very quickly used up in the body, and therefore not to be regarded as existing in

any sense on the same plane as ordinary articles of our dietary. One might legitimately state the case in this sense by comparing the body to a fireplace and food to the fuel placed therein. Ordinary food might be compared to the coals with which the fireplace is fed, producing slow combustion and affording a fair supply of heat. Alcohol, on the other hand, might be compared to straw which was used to stoke the grate. In this view alcohol contains combustible materials, but they, so to speak, are consumed in the body at such a rate and in such a manner as to be practically valueless in so far as ordinary nutrition is concerned. In the case of fever, on the other hand, alcohol is often administered with advantage.

The Summing up about Alcohol.—With reference to the amount of alcohol which a healthy individual is capable of taking per day without ill effect, Parkes, as the result of long-continued experimentation, showed that "1 to 1½ fluid ounces of absolute alcohol in twenty-four hours is the maximum amount which a healthy man should take." We are not here dealing with the question of *excess of alcohol*, capable, as every one knows, of producing dire effects on the body itself, ranging from the development of "drunkard's liver" (vol. ii.) onwards to a complete breakdown of the nervous system. The teaching of science regarding alcohol may be laid down—first, in the declaration that it is absolutely injurious to the young and growing body; in the second place, it is not a necessity for the healthy adult; in the third place, its uses are chiefly of a dietetic order; that is to say it may, and probably does, exert a certain effect on digestion. Like tea, and like coffee also, alcohol may probably, under certain conditions, have a power, popularly stated, of making the food go further. Certain experiments showed that when a number of healthy individuals were properly fed, the addition of alcohol to their food tended to produce a certain amount of digestive disturbance. When, however, the same individuals were under-fed, the same amount of alcohol appeared to exert a certain influence in maintaining the nutrition of the body up to a normal standard.

These views represent the main facts which science has up to the present time formulated regarding the use of alcohol. It is thus declared to be in no sense a necessity of life; and if it possesses the dietetic uses to which we have alluded, such usage affords no excuse for the common drinking habits of any country, far less for the abuse of alcohol, that is, for its use in excess. The temperance problem is undoubtedly, however, an extremely important and difficult one, having regard to the antiquity of alcoholic use, and to the widespread habit, even extending to savage nations, of its consumption in the form of a stimulant.

AIR, VENTILATION, AND LIGHTING

The composition of air has already been detailed in connection with the subject of the "Lungs and Breathing." It is only needful, therefore, in the present instance, to remind ourselves that air itself is a mixture of two gases—*oxygen* and *nitrogen*—these gases existing respectively in the proportion of about 21 parts of the former gas to 79 of the latter, measured by volume. In addition, ordinary air contains a certain amount of *carbonic acid gas*, which should not exceed (in fairly pure air) 4 parts in 10,000. The other matters found in ordinary air consist of a valuable quantity of water, traces of *ozone* (an electrified form of oxygen only found in the purest air) with traces of ammonia and of nitrous and nitric acids. The *floating matter, or dust of air*, in its turn may be regarded as consisting of two classes of substances—*mineral dust* (or inorganic matter), and, secondly, *organic dust*, consisting of *germs*, of which some are living and others dead. In addition, the *organic matter* of the atmosphere may be regarded as representing the worn-out cells or particles of animal and plant bodies.

The Importance of Air.—Having regard to the fact that a due supply of oxygen is perpetually required in order that all the vital actions, not merely of animals but of plants, may be carried on, the importance of a pure air supply can readily be realised. The composition of ordinary air as above detailed indicates fairly enough the matters which are breathed in. It need hardly be said that wherever animal life exists, the surrounding air tends to become more or less impure, by reason of the materials which are excreted from the lungs and skin into the blood, and thence into the atmosphere. Thus we naturally expect to find in an atmosphere in which animal life exists an increase of heat, watery vapour, carbonic acid gas, and other waste materials, the products of the work of the living body. Of the air impurities, there can be little doubt that *carbonic acid and organic matter* form those which the sanitarian has chiefly to consider in relation to the effects of impure air on the body.

Carbonic Acid Gas.—Carbonic acid gas (or, as it is more properly called, *carbonic dioxide*) is given forth into the atmosphere in the course of combustion, whilst the putrefaction of animal bodies also contributes to the atmospheric amount. In the case of fogs we find the quantity of carbonic acid in the atmosphere (normally 4 parts in 10,000 of air) to be largely increased. On the other hand rain and the influence of winds decreases the amount, as also naturally does an efficient system of ventilation when applied to our abodes

It may here be mentioned that another source of the removal of carbonic acid from the air is represented by green plants. The green parts of plants, and especially the leaves, are capable of absorbing this gas from the air. They decompose it into its constituent elements, namely carbon and oxygen, the plant retaining the carbon as food and allowing the oxygen to pass back into the atmosphere. Green plants may thus be considered in this sense to represent atmospheric purifiers. This action, however, takes place in the presence of light only. In the dark, the green plant absorbs oxygen and gives off, or exhales, carbonic acid gas. The quantity of this latter gas, however, excreted by the green plant in the dark is of very small amount, and is probably all re-absorbed. The popular idea that plants at night tend to render the atmosphere extremely impure, is one which as regards the theoretical aspects of the case, may possess a certain reality, whereas in so far as the practical result is concerned, the presence of green plants in an ordinary room can make extremely little difference to the night atmosphere.

Under certain circumstances, however, the quantity of carbonic acid may be largely increased through the presence of human beings, and especially through overcrowding. Analyses of air in various places, for example, has shown that the quantity of carbonic acid per 100 of air in the case of a schoolroom gave 0.241, an ill-ventilated bedroom at night 0.230, a public library reading-room 0.206, a tailor's workshop in Glasgow 0.217, in the Strand Theatre of London 0.101, onwards to the air of barracks 0.049, and to a street in London 0.040. A mine in Cornwall yielded in 100 parts of air 0.785, whereas in a convict prison the proportion was represented by 0.169. As showing the influence in promoting diffusion of gases and thus securing for us the purity of the atmosphere, it may be mentioned that analysis of the air in a London street on a windy day has given the proportion of carbonic acid as 0.36 per 1000. If this gas increased in amount to 75 parts per 1000 the breathing of air so laden would probably prove fatal. Even 15 parts per 1000 produce very distinct effects on human beings. It may therefore be said that for all practical purposes the limit of carbonic acid as regards the purity of the atmosphere may be set down at 4 parts (or at most 6 parts) per 10,000 of air.

Organic Matter.—The organic matter of the air to which reference has already been made, falls naturally to be included amongst the *floating dust* or suspended matter of the atmosphere. It has already been noted that much of this dust consists of mineral matter, that is of fine particles of sand and like materials. If the quantity of such dust contained in the air be very great, lung diseases are produced through its inhalation, a result seen in the case of

certain trades, to which reference will hereafter be made. In so far as the organic matter of the air is concerned, we find that dust of this description consists of starch cells, minute plant seeds, the germs or spores of moulds and other lower plants, along with germs or microbes, some of which, at least, are of disease-producing kind. In addition, we have to take into account that form of *organic matter* represented by the worn-out particles of animal bodies. This latter material becomes of extreme importance, seeing that its presence in any quantity in the atmosphere contributes to the development of disease. Typhus fever is an ailment which is specially associated with the organic matter of the air, inasmuch as its germs find in such matter a suitable soil in which to breed and multiply. Hence the presence of this fever in the slums of cities, where not merely dirt and poverty, but overcrowding and a want of fresh air are conditions typically represented.

Other Air Impurities.—It is necessary to bear in mind that impurity of the atmosphere of houses is especially increased by the presence of naked lights, that is to say by the burning of gas, lamps, or candles. It may be said that an ordinary gas-jet consuming say eight cubic feet of gas per hour consumes as much air, and gives forth to the atmosphere as much impurity, as a couple of human beings. In so far as the atmosphere of our houses is concerned we may hold that the evil effects of breathing impure air are not due so much to the presence of an excessive amount of carbonic acid gas alone as to the combination of this gas with organic matter. The close, stuffy smell of an ill-ventilated bedroom in the morning, for example, is owing to the organic matter present in the atmosphere, and it may here be said that in such a case the smell of the atmosphere presents a fairly reliable test of its impurity. When large numbers of human beings are brought together in meetings, as in concert halls, theatres, and like places, the quantity of waste matters which may be excreted becomes almost past belief. It has been calculated that 2000 persons remaining in a hall for three hours, excrete from their skin and lungs seventeen gallons of water, and exhale enough carbonic acid from the lungs and skin to represent, in so far as the carbon part of this gas is concerned, a hundredweight of coal.

Amount of Air Required.—Accepting the dictum that a healthy condition of life is utterly impossible save through the constant breathing of a pure atmosphere, we may now proceed to note how air impurities may be got rid of and a fresh air supply duly introduced into our homes and other places. As regards the quantity of fresh air required, we have to take into account that an average man will exhale 0.6 of a cubic foot of carbonic acid per hour. Having

regard to this amount and to the pollution of the air thus caused, sanitarians are generally agreed on the point that an adult man requires 3000 cubic feet of air per hour. If we imagine an individual to be confined in a compartment containing 1000 cubic feet of space, it might be supposed that if the amount of air in the compartment were renewed every twenty minutes, he would in this case be supplied with the amount of air just mentioned. This idea of renewing the air every twenty minutes is to allow 3000 cubic feet to be represented in the hour's supply. This plan, however, is not that of the sanitarian. What is demanded is that, through the ventilation of the compartment, enough fresh air would be passed inwards, and enough foul air carried outwards, so as to maintain the atmosphere of the compartment at the given standard of purity (4 in 1000 of carbonic acid gas), and in order to effect this end, it is found that 3000 cubic feet of air so circulated per hour would suffice for the man's wants.

The quantity of air required varies according to the age, sex, and the work of the individual. Children require less air than adults, and females probably less air than men. In the case of a man working extremely hard, he may require a supply of 9800 cubic feet of air per hour, whilst in light work the amount may be reduced to 4750 cubic feet per hour. In another mode of settling the question of air supply, reference is made to the amount of cubic space per head which should be afforded to each person. The typical amount would be 1000 cubic feet of space per head, but this amount is rarely attained save under favourable circumstances. Thus, in the lodging-houses of the poor not more than about 300 cubic feet may be allotted. This small amount may be further diminished in the case of slum dwellings. In barracks, 600 cubic feet is the minimum allowed for soldiers. In the case of hospitals the amount must naturally be increased. Not less than 1500 cubic feet is necessary, and 2000 cubic feet may be regarded as a more typical figure.

Ventilation.—Such considerations lead us naturally towards the subject of *ventilation* as the means to be employed for securing a continuous supply of fresh air. Ventilation is intended to accomplish two objects. There is, first, the getting rid of foul air, and, second, the introduction of fresh air *without unnecessary draught.* This last consideration is of extreme importance. It is easy to ventilate a room by throwing windows and doors open wide, but, having regard to climatic conditions, it is impossible to adopt this free and easy mode of ventilation without running serious risk of chill and cold. The whole subject of ventilation is one of extreme complexity, and it may here be said that it presents a subject the difficulties of which

have not yet been solved by sanitarians, having regard at least to the ventilation of ordinary dwelling-houses. Large buildings, hospitals, jails, halls, theatres, and the like, can be ventilated on scientific principles with much greater ease than a dwelling-house. A very important consideration in connection with ventilation is that which reminds us that air is a solid body, and that if we desire to empty a room of foul air, and to introduce fresh air in its place at a given rate and in a certain quantity, *we require to move the air in each case.* It is the impossibility of carrying out this practice in ordinary circumstances which presents the great difficulty of ventilation as applied to our homes.

Natural and Artificial Ventilation.—Two methods of ventilation have been relied on to effect the necessary change of atmosphere. It will be noted first of all that the sweeping out from a room of the entire atmosphere it contains is not a process which can be carried out by any scheme of ventilation. It is, as we have seen, practically the dilution of the impure atmosphere by an adequate amount of fresh air, such as is necessary to preserve its purity, and likewise the constant and gradual removal of the foul air, which represents the ideal process. Under the term *natural ventilation* are included all the ordinary modes of air renewal. Thus, natural ventilation depends on the action of winds, and also to a certain extent upon the differences of temperature represented between the inside of a house and the outside. A warm temperature tends to draw in the colder air from outside. Hence a certain amount of diffusion of air will take place even through the walls of rooms, and especially through porous materials of the nature of bricks and sandstone. The processes known as *perflation* and *aspiration* are represented in the action of wind. "Perflation" is represented by the rush of air into a room through open doors and windows. "Aspiration," on the other hand, represents the drawing out of air as it were, and is illustrated typically by a current of air blowing across the top of a chimney. It need hardly be said that upon these processes little dependence can be placed for a constant and regular supply of fresh air. As "the wind blows where it lists," so we find such processes fail to accord with what has been defined as scientific ventilation. The neglect of ventilation is typically seen in the fact that in an ordinary apartment when the door and the windows are shut, and the damper of the grate, as is too often the case, is closed, the room then becomes theoretically an air-tight box, without any appliance existing therein for its ventilation. But for the fact that the chimney, especially when a fire is lighted, forms an exhaust-shaft up which a constant current of air is passing from the room

and encouraging an inflow through the cracks and crevices of the windows and doors, each room would become a veritable "Black Hole of Calcutta."

Practical Ventilation.—In so far as the ventilation of an ordinary house is concerned, short of making such structural alterations in the building as would be necessary for the introduction of a special ventilating system, we are forced to fall back upon comparative simple methods. An inlet (Fig. 71) has to be provided for fresh air and an outlet for the foul air. It may generally be said that the inlets for fresh air should always be situated high up in the room, above the level of the heads of persons in the room. Again, the current of fresh air should be directed upwards, and in place of coming in directly in one stream, it is more advisable that the current of air should be broken up, so that it may gradually mingle with the air already contained in the room by way of diluting it. The outlets for foul air should always be placed near the ceiling, seeing that the polluted air, being warmer, rises.

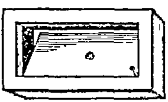


FIG. 71.—A Sherringham Inlet Valve.

Between-Sash Ventilation.—One of the simplest plans for ventilating an ordinary room, and one, besides, which has the great merit of being practically costless, is that known as Hinckes Bird's plan of "between-sash ventilation" (Fig. 72). The upper sash of the window is left closed, while the lower sash is raised three or four inches. A block of wood is then placed along the lower part of the window-sill, so that the bottom of the lower sash rests upon it. In this way the top of the lower sash is raised three or four inches above the bottom of the upper sash, and air comes into the room between the sashes. The force of the incoming current of air is broken against the inner sash, and it tends thus to pass into the room without unnecessary draught. Modifications of this plan are found in the idea of placing double panes of glass in the window, an open space being left at the bottom of the outer one, the air passing in entering the room at the top of the inner pane. What are known as "Louvre ventilators" are also well known as applied to windows. In other cases a movable circular pane opens or shuts, according as its openings come opposite or not to apertures cut in the glass outside it. Tobin's plan of ventilation (Fig. 73) consists in introducing air through the outer wall of houses

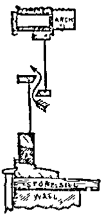


FIG. 72.—Hinckes Bird's System of Between-Sash Ventilation.

at the floor level. This air passes into tubes placed in the corners of rooms, the tubes rising to a height of from six to eight feet. The air currents passing into the room are thus diffused, and pass downwards. The apertures of the tubes in the rooms may be closed by valves. In such cases an outlet valve may be placed near the ceiling, opening into the chimney; this valve allowing air to escape into the chimney, but preventing smoke coming into the room. The defect of these valves, however, is that they will only act when the pressure of air from the room into the chimney is greater than that from the chimney into the room. *Ventilating bricks* of a special pattern are also provided in many cases. These bricks are perforated with tubes, the inner ends of those opening into the room being larger in diameter than the outer ends, so that the currents of air entering are gradually diffused into the room in this way. Other modes of ventilation found in houses are connected with the lighting arrangements. Thus ventilated gas lights are well known, the products of combustion being carried off by a tube specially connected with the lighting apparatus. Sunlight gas burners in the same way are usually connected with tubes or shafts which act in removing the foul air.

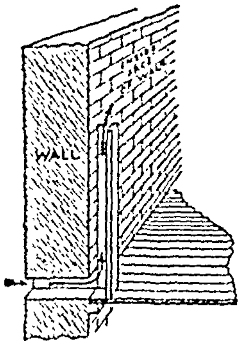


FIG. 73.—A Tobin's Tube.

Public Buildings and Ventilation.—In the case of public buildings it may be said that all forms of ventilating apparatus which depend for their action upon the wind or ordinary air currents, are more or less defective. They are modelled very much on the type of a well-known ventilator called "M'Kinnell's" (Fig. 74). This consists of two tubes, one tube being placed inside the other. Such ventilators are frequently found in the ceilings of large halls, the outer ends of the tubes piercing the roof and being carried into the outer air. Theoretically whilst the inner tube carries foul air out of the building the outer tube carries fresh air into it, and the flange at the end of the outer tube along the ceiling line diffuses the air into the building below. Speaking of ventilators modelled on this type Sir Douglas Galton remarks: "All these ventilators act as desired in a closed room, but as soon as a door or window is opened they become simply upcast shafts; they cease to supply air; and the air supply comes in from the other openings. Again, if there be a fireplace in the room,

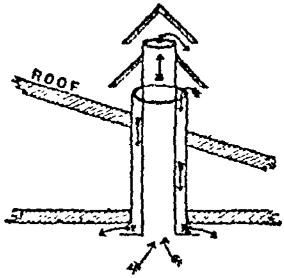


FIG. 74.—M'Kinnell's Ventilator.

with a strong fire in it, and the doors and windows shut, the fire will supply itself from these ventilators and they will become inlets."

A Dream of the Future.—Having regard thus to the great defects which attend the adaptation of any kind of existing ventilating system to houses, one may well be tempted to indulge in what may be called a sanitary dream. When as a nation at large we awake to the absolute necessity for a constant supply of fresh air as a condition without which health cannot be maintained, we may possibly find in future that in place of each house having a separate ventilating apparatus, fresh air, cooled in summer and heated in winter, may be supplied to the houses of a district or town from a central pumping station very much as gas or water is supplied to us to-day. Air pipes led into the rooms and provided with taps would enable the inhabitants to enjoy a constantly pure atmosphere. This system would also include the removal or extraction of foul air by a second and different set of pipes. Such a scheme is perfectly within the compass of engineering science, and it only requires the existence of a demand in order that a fresh air supply of this kind should be provided.

Artificial Ventilation.—The idea of *artificial ventilation* is that of treating the air as a solid body, and of compelling it to move in certain directions by means of machinery. In one sense the action of a fireplace may be regarded as representing artificial ventilation, seeing that, as has already been mentioned, a column of heated air in the chimney ascends and is replaced by an equal volume of colder air. In the same way ventilation by a sunlight burner may be regarded as representing an artificial mode of ventilation. We also find in mines that the furnace placed at the foot of the upcast shaft draws in air from another shaft, this air passing through the passages of the mine and finally being drawn upwards by the action of the furnace. The Houses of Parliament are ventilated on the same principle through a furnace placed at the bottom of the Clock Tower. The outer air is introduced into the basement, where it is warmed, filtered, or cooled, as the case may be. It passes into the House through the floor, then ascending to the ceiling is drawn down into the basement of the Tower, where the furnace provides an up-draft, the foul air of the Houses of Parliament thus escaping into the atmosphere of London by the top of the Tower.

Jebb's system of ventilation for prisons exhibits the same principle, with the exception that the furnaces exist on the roof of the prison and thus extract the air from each cell. Fresh air enters the cells by openings near the ceilings, the foul air being sucked out at the floor level and carried by flues to the roof. In the basement of the prison

the air is warmed in winter by hot water pipes. In other cases an up-draft may be caused by gas jets kept burning in special shafts.

Propulsion of Air.—What is known as ventilation by propulsion consists in the mechanical action of fans or similar appliances upon the air. Here we find a mode of ventilation specially adapted for keeping pure the atmosphere in large buildings, typically halls, theatres, warehouses and the like. In particular in cases of factories where much dust is present, the action of the fans is found to be exceedingly valuable in clearing the atmosphere and preventing lung diseases caused through breathing dust particles. The fans may be used to propel air into the basement of a building, where it can be warmed by being passed over hot water pipes. From this chamber the air is carried by tubes to the various rooms. From the tubes large channels open into the rooms seven or eight feet above the level of the floor. The velocity of the air impelled by the fans is great, so as to carry the air upwards and to diffuse it through the atmosphere of the chamber. It finally passes into outlet shafts which discharge at the roof. In other cases fans may be used for the extraction of air as well as for its impulsion inwards. This system of ventilation naturally requires machinery in order to provide for the due movements of the fans, many such fans being now readily connected with an electrical supply and being propelled by electrical force.

A Test for Air.—The accurate analysis and examination of air is a matter for the chemist and the bacteriologist. As in the case of a water supply, attention is now paid by sanitarians to the number of microbes or germs which air contains. It may be said that the more heavily charged with microbes an atmosphere is, the more impure it may be considered to be. Thus air examined 120 miles off the land contained no microbes whatever. The air on high mountains was found to contain one microbe or so per cubic metre of air. (A cubic metre of air equals in English 220.09 gallons or 35.3 cubic feet.) In the Mid-Atlantic Ocean the air contained six microbes per cubic metre. These accounts may be regarded as practically giving a negative result in so far as the presence of microbes is concerned. At the summit of the Pantheon in Paris, 200 microbes were found in the same amount of air, but at the Hôtel-de-Dieu, one of the hospitals of Paris, no fewer than 79,000 microbes were found in each cubic metre.

A simple test for air which can be readily applied is that of the late Dr. Angus Smith. A bottle of the capacity of 10½ oz., wide mouthed and stoppered, is taken. The room the air of which is to be tested must have been kept completely closed Into the bottle before

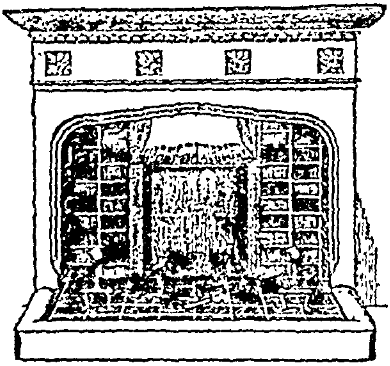
proceeding into the room a silk handkerchief should be stuffed. Immediately on entering the room and closing the door, this handkerchief should be rapidly switched out of the bottle, thus removing the air originally contained therein and allowing the air of the room to enter the bottle. This test also includes the use of clear lime water, which should itself be kept in a stoppered bottle. If half an ounce of lime water be placed in the bottle containing the air of the room to be tested, the stopper replaced and the lime water shaken up, the impurity of the air may be judged from the amount of milkiness which the lime water will exhibit. This milky appearance is due to the fact that carbonic acid gas unites with the lime of the water to form carbonate of lime or chalk. If any such result is seen, we know that the air contains more than six parts of carbonic acid gas in 10,000, this amount being incompatible with the preservation of health. If the lime water remains clear, we may conclude that the air is practically of pure character.

WARMING AND LIGHTING

With regard to the warming of the home, this is a subject which is closely allied to ventilation. The temperature of rooms is raised either by open fireplaces, by closed fireplaces and stoves, by pipes containing hot air, or by hot water pipes. There can be little doubt that the ordinary open fire is an extravagant mode of consuming fuel, inasmuch as a very small proportion of heat escapes into the room from the fire, the larger proportion passing up the chimney. At the same time we must not neglect the fact that the open fireplace, as we have seen, is a means of ventilation for rooms which would otherwise be destitute of any such appliances.

Teale's Grates.—Mr. Teale of Leeds, in suggesting improvements which would adapt the ordinary grate to be a more efficient heating apparatus, recommends that as little iron and as much firebrick should be used as possible, the back and sides of the grate being specially constructed with firebrick. He suggests that the back of the fireplace should project over the fire, and that the chimney opening should be more contracted than is usually the case. Again, the bottom of the fire should be deep from before backwards, and the slits in the bottom of the grate of narrow character. The bars in front, it is also recommended, should be narrowed, and finally, the space beneath the fire should be closed in front by an iron shield. Of Mr. Teale's system, this last has proved one of the best features. Among other numerous patterns

of grate, that known as the "Well Fire" (Bowes' patent) may also be commended to the attention of those who desire a larger amount of heat with a more limited consumption of coal. The great advantages of the "Well Fire" are that it consumes less coal, that the air is heated before being consumed in the grate, that it provides for room ventilation and that it needs no attention. In a case known to the writer, a "Well Fire" burnt for twenty hours without requiring fresh fuel, the heat of the room being well maintained during this period. In the case of *gas-fires*, care should be taken that an adequate chimney or flue is provided for carrying off the fumes. We should endeavour in all cases where these fires are used to provide for ample ventilation. In the case of *stoves* a more economical mode of consuming fuel is found, but there can be little doubt that the stove is much inferior to the open fireplace as a means of ventilation. In some cases ventilating stoves are used, air being conveyed through special tubes or pipes. These tubes are heated by the stove, and in one pattern at least, the fresh air pipe is coiled inside the stove. The chief objection to a stove is that it tends to make the atmosphere in the room of a dry and hot character. To avoid this, vessels containing water are placed upon the stoves, the evaporation of the fluid tending to produce a certain degree of moisture in the surrounding air. Stoves should be made of wrought-iron, inasmuch as in cast-iron stoves rapid oxidation is apt to take place, with the result of causing a disagreeable odour in the room.



75. The "Well Fire."

Hot air may be used both in houses and in large buildings. The air is warmed in the basement and conveyed by special channels to the other parts of the building. A stove or fireplace in the hall of a house to a certain extent may provide a supply of hot air. Hot water or steam is circulated in a system of closed pipes. The hot water is generally used below 212 degrees Fahrenheit. The circulation takes place between the house and the boiler, the water leaving the boiler in a hot condition and returning to it in a cool condition. A cistern is provided for feeding the boiler, and safety-valves are also required providing for the due escape of steam and air. With regard to the various modes in which these forms of heating act, we may say that while the ordinary open fire acts by the *radiation* of heat, hot air warms a room by what is called *convection*. In the case of stoves

and hot water pipes, radiation is represented as well as convection. The difference between these two results is that from radiation the air may be maintained at a fairly low temperature provided sufficient ventilation be present. In the case of convection the air is heated and dried, and a certain amount of moisture is therefore required.

Lighting.—With regard to the lighting of the room, we find that the standard or unit of lighting is denominated under the name of *candle-power*. The French use a unit of light which is equal to 9.3 English candles. The English method is that of calculating a light equal to that of one such candle. Applied to gas, it is represented by a flame 2½ inches high, coming from an opening a quarter of an inch in diameter. With regard to the various forms of lighting, lamps are now generally represented by those of the paraffin kind. A lamp of this kind is estimated as consuming 62 grains of oil per hour for each candle-power, this amount giving off in the way of waste 0.28 of a cubic foot of carbonic acid gas and 0.22 of a cubic foot of water. With regard to paraffin oil, it is eminently desirable that the flashing point should be very much increased. In the case of lamps, they should be made with broad bases so that they may not be easily toppled over. The oil receptacle should not be filled up to the top, and it should not be allowed to sink very low before being renewed. Gas lighting has been immensely improved of late years by the adoption of special forms of burners, amongst which the various types of incandescent burner are prominent.

Gas Consumption.—It is estimated that each cubic foot of ordinary coal gas gives off as a result of its being consumed 0.52 of a cubic foot of carbonic acid and 1.3 of a cubic foot of water. It may be held that an ordinary gas burner of the "fish tail" or "bat's wing" order gives a light of 16 candle-power, and consumes per hour 4 to 5 cubic feet of gas. Burners of an inferior character consume much more gas with a yield of light much under that just mentioned. In the case of the incandescent light, a "mantle" of asbestos material is used. The material is made to glow in the act of combustion. It gives a very brilliant light, and besides, presents the additional advantage of being economic in its gas consumption. Naturally, the introduction of the electric light has solved many of the problems of lighting. Here we find a light which, although it undoubtedly gives off a certain amount of heat, nevertheless consumes little or no air, and thus tends to preserve the purity of the surrounding atmosphere. There can be little doubt that with the improvement of electrical appliances, and the extension of the use of the electric light, great improvement in the air purity of dwellings will be ensured.

PERSONAL HABITS

A large portion of the practice of hygiene is concerned with our personal habits. Here we come face to face with the work of the individual in duly regulating his bodily affairs, and in supervising the physical requirements of his frame. This phase of health science is naturally opposed to that which, taking mankind in the mass, so to speak, as represented say by the dwellers in a great city, concerns itself with the means to be adopted for the prevention of illness in a community, and the prolongation of life at large. Each individual may thus be said to possess two distinct phases or aspects when regarded from the hygienic standpoint. In the first place, as a civilised man, he is a citizen and member of a community to the other members of which he owes certain duties in the way of preventing disease, just as in turn they owe to him the performance of a like duty. In the second place, we have the personal aspect of hygiene just alluded to, whereby the individual unit practically seeks to conserve his own physical welfare by putting into practice those laws of health which have more especially a bearing on the wants and requirements of the individual existence. The whole question of personal hygiene may be summed up in the expression that the mode of life or habits of the individual contribute very largely to the maintenance of health on the one hand, or in the case of injurious habits to the development of disease on the other. Under this head fall to be considered such subjects as are represented by *sleep, clothing,* the *care of the skin and hair,* and the general exercise of *personal cleanliness,* included in which latter subject we naturally find the topics of *baths* and of *soap.*

Sleep.—The necessity for a certain amount of repose and rest demanded by the body generally is typified naturally in every vital action itself. It may be said that no organ of the body works continuously, or at least no organ exists which does not exhibit a certain periodical relaxation of its duty. Even the heart, as has been shown, rests really as much as it works, being in the position of a workman taking short spells of rest between short spells of labour. The liver's duties are considerably slowed down, so to speak, during sleep, and the action of a person waking in the morning, rubbing his eyes on waking, is devoted to causing the tear glands to resume their work, that of supplying the fluid whereby the surface of the eyeball is kept moist. Of sleep it may be said that no other phase of bodily life can in any sense make up for want of repose. Sleep itself may to a certain extent replace food, as also may warmth, and the

practice of Lancashire women, during the great cotton famine, of putting [illegible] them warm with blankets, was a [illegible] much as the bodily output being t[illegible]d, whilst external heat was supplied, the lack of food was to a certain degree made good. On the other hand, without a due allowance of sleep a healthy life is *impossible*. If *sleep can to a certain extent replace food*, it is equally certain that no amount of food can replace sleep, for the reason that the central nervous system demands repose in order to restore the vital force or energy of its brain cells. The need for sleep is much more definitely represented in the earliest period of human life than in the adult state. The young infant spends the larger portion of the *first months of its life in sleep. In this way the process of nutrition and that of body building are largely aided, seeing* that in the prolonged periods of sleep of the child we have the processes of work, and therefore of waste, greatly limited, and every facility given for the function of body building to take place easily and naturally.

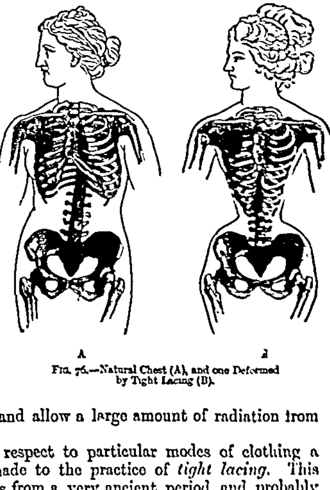
Periods of Sleep.—Calculations have been made that at four years of age 12 hours of sleep are required as the normal amount, at seven years the period is set down at an hour less, at nine years $10\frac{1}{2}$ hours are required, at twelve years 10 hours, at seventeen years $9\frac{1}{2}$ hours, at twenty-one years 9 hours, and from twenty-eight to thirty years onwards, through adult life, a period of 8 hours appears to represent the natural amount of repose. In old age the need for a large amount of repose is demonstrated equally with the necessity which is represented in infancy. In the aged person the forces of life are naturally much lessened, and therefore the additional amount of repose demanded at this period of life goes to the credit, first, of the nutrition of the body, and second, to the saving of wear and tear, the last being an essential feature in the conduct and character of a healthy old age.

In so far as the conditions for healthy sleep are concerned, the *bedroom should be quiet, provided* with blinds of dark colour not permitting access of light, whilst, above all, its ventilation should be of as perfect an order as possible. If we are troubled with impure air during the waking hours we can readily obtain a pure supply, but when we go to sleep we are at the mercy, for seven or eight hours, of whatever atmosphere a bedroom may contain. The tired, worn-out feeling of which many persons complain on rising from bed in the morning, is not due to want of sleep, seeing that they may have slumbered through the watches of the night, but represents the effect on their brain cells of breathing an impure atmosphere during sleep. The bedclothes should be varied according to the season of the year

The practice of using eider-down quilts in place of many layers of heavy blankets is one heartily to be commended, inasmuch as a greater amount of warmth is in this way acquired, with an absence of the heavy weight of the old-fashioned bedclothes.

Clothing.—Man may be said to adopt different clothing materials according to the climate he inhabits, and variations are also made in clothing according to the seasonal variations of the year. As a rule, however, even amongst primitive men, certain broad conditions or laws regulating the nature of the clothing, especially in its seasonal differences, may be found represented. In the first instance, *colour*, to a certain extent, may be regarded as a feature of clothing which must receive a large amount of attention. The hue of our clothes falls to be regarded in relation to the question of heat, and, with that, of protection from the solar rays. Naturally, in summer, as in the hot season in tropical climates at large, white is the colour chosen, on account of the fact that such fabrics absorb the least amount of heat, whereas black or dark-coloured garments absorb the greatest amount. The *texture* of the clothing is also an important point, inasmuch as the denser the texture of the fabric is, the less freely is the moisture of the skin allowed to pass through its fibres. We must bear in mind yet another point in connection with clothing. The power of clothing to keep us warm does not depend upon any inherent heat-producing qualities in the clothes themselves. All our heat, is, so to speak, manufactured on the premises; in other words, it is produced by processes of chemical combustion in the body itself. The proper function of clothes is therefore, on the one hand, to prevent the escape of heat from the surface of the body in winter, and, on the other hand, to favour the escape of heat in summer. In so far as protection against cold is concerned, wool is undoubtedly much superior to cotton or linen; there is little to choose between cotton and linen in respect of their heat-retaining qualities, both being much inferior to wool. For protection from cold winds, a high authority says that leather and indiarubber fabrics take the first rank, wool coming second, whilst cotton and linen may be rejected in respect of such qualities. Again, with regard to the absorption of perspiration, wool is the only fabric which can be depended on; hence the danger incurred by many persons of sustaining a severe chill through wearing linen or cotton next the skin, as these fabrics, becoming extremely damp after exercise, tend unduly to lower the body temperature. With reference to the clothing adapted for malarious districts, there can be little doubt that the wearing of wool next the skin lessens the risk of acquiring such affections. The protection of the skin in this way conduces towards maintaining the general health of the body.

Dr. Andrew Combe, relating his experience long ago, insisted upon the necessity of having woollen clothing next the skin by way of warding off malarial troubles, and similar experience on the West Coast of Africa would appear to point to the same result. With regard to waterproof clothing, which is worn as a protection against wet, it is of extreme importance that these garments should not be worn longer than is necessary, and also that they should be provided with efficient means for their ventilation. In the most improved makes of waterproof garments due ventilation is secured. The great point as regards clothing, we therefore note, is not merely that it should afford sufficient protection against cold in winter, but should likewise, when chosen for summer, preserve a certain degree of coolness. Thus practically in winter we wear, as has been shown, bad conductors of heat, in the shape of wool, down, and fur, these fabrics at the same time possessing the greatest hygroscopic powers—that is, powers of absorbing moisture. The lighter materials, such as cotton and linen, are themselves necessarily cool, because they are good conductors of heat, and allow a large amount of radiation from the skin.



A B

FIG. 76.—Natural Chest (A), and one Deformed by Tight Lacing (B).

Tight Lacing.—In respect to particular modes of clothing a reference may here be made to the practice of *tight lacing*. This practice undoubtedly dates from a very ancient period, and probably first came into prominence during the decadent period of Greece and Rome. Women then began to constrict the lower part of the chest for the purpose of throwing the breasts out into greater prominence, and of emphasising the size of the hips. In plain language tight lacing owed its origin to a purely sensual practice of womankind at

the period of history noted, and although undoubtedly the habit may have lost much of its significance to-day, its effects on the female form remain as in classic ages. It is not necessary to enter here into detail regarding the injurious effects of this practice. The human chest is shaped like a cone, the apex in front of the cone existing at the top, the base forming the lower part of the chest where the thorax joins the abdomen. If the lower ribs be constricted (Fig. 76, B) by means of tight corsets, we have as a result serious deformity of the chest produced, and consequent displacement of many internal organs. The liver is thus displaced downwards, whilst other and important effects are produced upon the stomach, bowels, and even on the womb itself. In addition, the vital capacity of the chest is much lessened, so that the functions of breathing cannot be perfectly carried on through the want of power to inflate the lungs fully, and heart disturbance has also to be taken into account as a necessary consequence of this barbarous practice. Only the common sense of womankind, and an education in the laws of hygiene, can be relied upon to abolish this injurious habit. An excuse is generally made for the practice of tight lacing in the shape of the necessity for the corset as a means of suspending under garments therefrom. Such suspension could just as easily be accomplished from the shoulders. If corsets be worn at all, great care should be taken in fitting them, so that no injurious pressure is exercised. The principle here represented is simply that of the boot itself. The corset should be made to fit the figure easily, without causing pressure, just as the boot ought to be made to fit the foot instead of, as is too often the case, the foot being deformed in order to fit the boot.

Boots and Shoes.—A few words need only be devoted to the subject of our footgear. As has just been remarked, it is of importance that boots and shoes should fit the feet thoroughly, this being the first condition to avoid foot deformity. Mothers should note that a considerable amount of pain is unwittingly caused in young children, whilst also foot deformity is commenced in infancy, by their want of care in seeing that the first shoes of their offspring fit easily. In many cases the feet of young children are unduly compressed, and foot deformity might therefore be said to be brought on at a very early stage indeed of the career of the young human being The commonest deformity is that in which the great toe and the other toes being compressed by a badly fitting boot, a tendency is shown for certain of the toes to override the others. A frequent instance of this kind is seen where, say, the second toe is completely covered, so to speak, by the third toe and by the great toe. It is not necessary, as some persons are inclined to believe, that hygienic boots and shoes,

that is to say footgear which is of a comfortable nature, should be clumsy in appearance. Bootmakers are perfectly familiar with the rules according to which the feet should be conveniently and comfortably shod. A highly reprehensible practice is that represented in the case of women wearing boots with high heels and heels frequently projecting or slanting almost into the middle of the foot. Here we find the heel bone practically deprived of its functions, namely that of serving as a natural fulcrum or support for the body in the erect position. Any woman wearing boots or shoes of this description cannot possibly walk in a natural fashion, whilst such boots, throwing the weight of the body unduly forward, tend to destroy not merely the beautiful arch of the foot which runs in the long direction, but also to weaken the ligaments which sustain the bones forming the other arch crossing the foot.

The Hair.—Care of the hair forms an extremely important part of our personal hygiene, seeing that regarded even from the lowest standpoint the head covering forms a by no means unimportant accessory to beauty. Diseases of the hair and the treatment of baldness will be found duly treated in the section of the work dealing with diseases of the skin. With reference to the hair a caution may here be given that the practice of wetting the head in the morning bath is one which directly tends to encourage baldness. The hair may be washed once a week or so, in order to remove the dust which accumulates in it, but the too frequent washing of the head has the effect of removing the natural oil of the skin thrown out by the sebaceous glands described in the section dealing with the skin structure. The hairs are thus deprived of a kind of natural oil or pomade, and baldness is in this way induced in many cases. With reference to the care of the hair we should remember the soldier's axiom, "where there is hair there is dirt," hence the necessity in the case of women for the hair being duly washed at intervals, and also in the case of men of equal necessity for the hair being cut short, or at least kept of only moderate length. The brushes used for the hair should be of medium hardness. There is not the slightest advantage, but on the contrary a considerable amount of likelihood of injury being done, by using extremely hard brushes. The vast majority of persons benefit by applying to the hair each day some simple fluid containing oil. Whatever lotion is used to the hair should not contain a large amount of spirit, inasmuch as preparations of this kind, known under the general term of "Brilliantine," are apt to produce excessive dryness and premature greyness of the hair. One of the simplest, but yet at the same time extremely serviceable hair preparations adapted for ordinary use, a little to be applied to the hair each

morning, is composed of 4 drachms of castor oil, 28 drachms of olive oil, 12 drachms of glycerine, 4 drachms of rectified spirit, 8 drachms of scent, and 1 drachm of tincture of cantharides. Where any hair weakness results with commencing baldness, the treatment alluded to in the section dealing with diseases of the skin may be adopted, but a simple hair stimulant adapted to restore the tone of the hair is composed of 2 ounces of eau de Cologne, 2 drachms of tincture of cantharides, 10 drops each of oil of rosemary and oil of lavender, and 1 drachm of castor oil. A little of this preparation should be rubbed into the scalp each evening.

Baths.—The function of the bath may be regarded under two heads. In the first instance, it may be regarded as a cleansing measure, when aided by the use of soap, and also by temperature, this last being represented either in the heat of the water itself, or by arrangements made as in Turkish, Russian, and other baths to produce copious action of the skin. With reference to the temperature of baths, the cold bath is generally regarded as that which shows a temperature below 60 degrees F. downwards. The cool bath ranges from 60 to 75 degrees F. The tepid bath is that which shows a heat of from 85 to 90 degrees F. The warm bath ranges from 92 to 98 degrees F.; whilst hot baths exhibit a temperature ranging from 98 to 112 degrees.

It is important to distinguish between the effects of cold, tepid, and warm bathing. The *cold bath* must be regarded as a stimulant merely bracing the nervous system, and also producing a certain effect on the bodily processes generally tending to the increase of vital action, and in all probability also to the acceleration of excretion or the getting rid of bodily waste. It is important to note that in so far as the cold bath is concerned, the test whether or not this measure is doing good, may be found in the presence of what is called *reaction* after the bath. The individual should not remain in the bath for any length of time, but indulge in a rapid sponging with cold water, thereafter undergoing a thorough rub-down by aid of a rough or bath towel. If a glow of heat is experienced after the bath, that feature indicates that it has done good. Where, on the other hand, symptoms of chilliness appear and shivering is present, the practice of cold bathing had better be renounced. The *hot bath*, on the other hand, might be described as more or less of a detergent or cleansing measure, more especially when the action of the hot water is aided by that of soap. Other forms of baths, known as vapour baths, depend upon the effect of hot vapour in inducing a particular action of the skin. Such baths can also be associated with the process of *massage* or shampooing the muscles. The effects of these procedures are to remove a very large

quantity of waste matter or *débris* from the skin, and also to induce a feeling of renewed vigour.

With regard to *sea-bathing*, the chief precautions to be noted here are that this practice should not be undertaken within two or three hours after a meal. In the second place, the bather should avoid entering the water when he is either tired or fatigued, and more especially when he is chilled. When the body is warm no ill effects will be experienced from entering the sea or river, more especially if the bather is a swimmer, and can therefore indulge in a certain amount of exercise in the water. Cases of cramp resulting in drowning chiefly arise from some disturbance or other affecting most probably the heart, and induced by neglect of the rules just mentioned. A recent development of the *vapour bath* has brought this useful mode of treating the skin within reach of almost everybody. Appliances are now universally sold for home use, whereby the patient, enveloped in a case out of which his head projects, has his body subjected to the influence of vapour arising from a small kettle heated by spirits of wine, thus producing the necessary vapour. Modifications of this bath are also capable of being made, and in many cases of chill, which if left unchecked may lead to serious results, a bath of this kind taken at the proper time is found to be sufficient to ward off attacks.

Soap.—Soap represents practically a combination of soda or potash with a fatty acid, such an acid being represented by stearic, oleic, or palmitic acid. Practically, soap is therefore a combination of an alkali with a fat. In the result of soap-making, from the action of the alkali upon the acids and the fat, an alkaline compound is formed, whilst in the course of the process glycerine is produced. Potash soaps are represented by *soft soap*. They contain a very large amount of water, and exist more or less in the form of a jelly. Ordinary soaps are made with soda. They contain a small amount of water, and from their consistence are known as *hard soaps*. Soap which can be used for washing in salt water consists of soda or potash combined with cocoanut oil. Yellow soap is composed of resin combined with tallow and oil, the fatty matter being derived from ordinary kitchen refuse or bone fat. In the better class of toilet-soaps we find vegetable oils, or lard, or beef marrow used to represent the fatty constituents. Processes of purification are duly represented in their manufacture, and some scented material added. Any colouring matter added to soaps of a fine quality is of a harmless character. Glycerine soap consists of ordinary materials to which glycerine has been added. Transparent soaps are first dried and dissolved in alcohol. After filtration, the alcohol is removed, and the soap fixed by being run into moulds.

Action of Soap.—In all probability the action of soap in cleansing the skin is due to the fact that so much of the alkali is liberated, this uniting with the grease of the skin and forming, according to some views, a kind of secondary soap through the action of which dirt is easily removed. At the same time the exact nature of the cleansing action of soap is regarded by many authorities as still presenting many difficulties for solution. With reference to the use of soap considerable improvements have of late years been made in respect of the manufacture of soaps which combine a large amount of cleansing power without inducing skin irritation. It is of great importance that cheap and inferior soaps should be avoided. These are not merely over-loaded with water but are frequently coloured with substances calculated to injure the skin. One of the best soaps in respect of its pure quality and absolute freedom from all injurious properties is that old established and long known as "Pears" soap. Equally for the delicate skin of the infant and for that of the adult this soap may be thoroughly recommended. Superfatted soaps are also largely made at the present time, and owe their popularity to the fact that they contain a certain excess of oily matter which may be presumed to counteract the effects of the alkali they contain upon the skin.

Tobacco.—The question of tobacco smoking is one which naturally falls to be discussed in dealing with personal habits. It may be said first that tobacco smoking is, like alcohol drinking, absolutely injurious to the young. Hence the common practice of boys smoking cigarettes is one which must be roundly condemned. The effect of tobacco here is to interfere with the composition of the blood, and to induce a state of matters injurious to the body-nutrition itself. Juvenile smoking thus seriously affects the growth of the young individual. In so far as the adult is concerned it may be said that each man is a law unto himself as regards the effects tobacco produces on his system, and also regarding the amount of tobacco he is capable of consuming without harm. Very great variations are seen in individuals in this latter respect. The practice of smoking may be regarded as essentially that of consuming a certain amount of a sedative or narcotic substance. In all probability the tobacco habit exercises a certain power over all mankind through the soothing effects which it is capable of producing.

Tobacco Excess.—When taken in excess, tobacco has an extremely depressing influence upon the heart, producing an irregular pulse, heart pain, and other symptoms. Such excess also has a distinct effect upon the eyes, and gives rise to a condition known as "tobacco blindness." In each case the cure can only be commenced by the individual absolutely renouncing the smoking habit altogether,

whilst he will require proper treatment under the hands of a medical man in the way of tonics and other measures calculated to counteract the effects of the excess. The morning pipe or cigar is valued by many persons as a preventive of constipation. This fact is no doubt produced by the well-known action of tobacco on the muscular system, in this case the effect being conveyed to the muscles of the bowels tending to cause intestinal action. Tobacco, unlike alcohol, does not produce the widespread and disastrous effects which over-indulgence in drink is capable of bringing about. All that is necessary to be said in relation to this subject is therefore contained in the caution that the young should not be permitted to smoke at all, and that all excess should be avoided by the adult.

THE HOUSE AND ITS HEALTH

It is only expressing a truism to assert that a healthy home must exercise a very potent influence on health, as conversely an unhealthy home must be regarded as equally powerful an agent in inducing disease. The conditions which have to be regarded with reference to the housing problem are, first, represented by the question of soil; second, by the preservation of sufficient air space around the house; third, by the construction of the dwelling itself; and fourth, by the perfection of its drainage arrangements designed for carrying waste products away from the dwelling. It need hardly be said that the housing problem has of late years become one of intense interest to sanitarians. The rapid growth of great centres of population tending towards overcrowding, with consequent increase of disease, has given to this subject an extreme interest. Carefully compiled statistics show us that the mortality from all causes and at all ages, is much greater in houses of one room than in houses of three or four rooms. The conditions of such life to-day in fact include many phases of life which are entirely opposed to the maintenance of health.

Different countries exhibit variations in their mode of housing. Thus in most English towns houses are of a self-contained description, whereas in Scotland and in France the flat system has long been prevalent, and huge blocks of tenement buildings divided into separate houses, the rooms in many of which are too small, producing overcrowding of a different kind from that seen in the slums but none the less interfering with healthy conditions. In many English cities the demand for house room has also evolved the flat system. It need hardly be said that with regard to huge tenements the presence of infectious disease is much more liable to make itself felt by its extension

through the closely associated habits of the people, than in other case where houses are of a self-contained description.

The Soil.—With regard to the soil upon which a house is set thi should in the first instance be of a *dry character* (Fig. 77). That dampness of soil tends to the production of disease is a well-known sanitary fact. Long ago it was shown that the death-rate from consumption decreased in cities and towns which in consequence of better drainage arrangements got rid of their subsoil water. This fact was found to be true of England and of America likewise. In certain towns the mortality from consumption fell from 50 per cent. downwards as a consequence of improved drainage. In Salisbury the mortality fell 49 per cent., in Ely 47, in Rugby 43, and in Banbury 14. In thirteen other towns a reduction in the consumption death-rate was also noted. In other towns again, in which the subsoil water had not been drained, the death-rate from consumption remained stationary, and in certain towns where in consequence of their flat

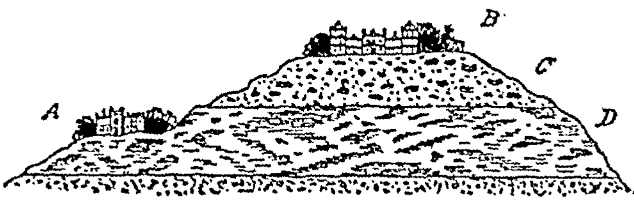


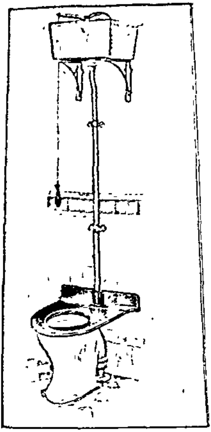
FIG. 77.—Diagram showing a Healthy Site (*B*) for a House on Open Strata (*C*); and Unhealthy Site (*A*) on Clay (*D*).

and low-lying nature affluent subsoil drainage could not be carried out, no effect on the consumption death-rate was produced because the nature of the soil favoured a continual water-logged condition not materially affected by the drainage improvements. It should here be noted that whilst good drainage will improve an otherwise unhealthy soil, a perfectly healthy soil may be rendered unhealthy through defective sewage arrangements. In certain towns where such arrangements have been of defective character the soil becomes practically "filth-logged," with the result that epidemics of typhoid fever are consequent probably upon the rising of the subsoil water.

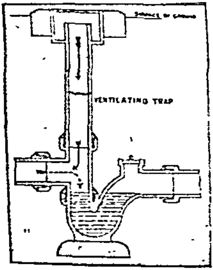
Another important point with regard to the erection of houses is that which refers to their being built on what is called "made-up" ground. This ground practically represents a hole or hollow which has been filled up by carting rubbish of all descriptions into it. It need hardly be said that such filth foundations are utterly unsuitable for the erection of dwellings thereon, and it is most desirable that local building laws should forbid the erection of dwellings in any such localities.

The Aspect of the House.—The front of a house where a

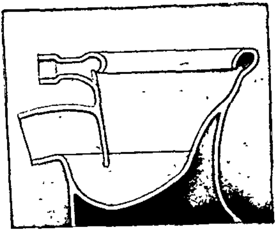
HOUSE DRAINAGE.



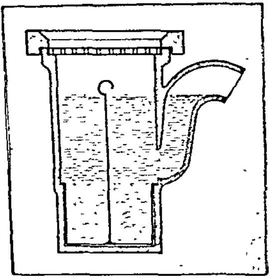
Modern Syphonic Closet.



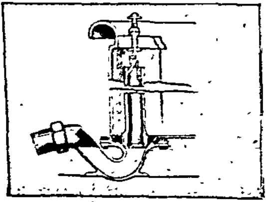
Ventilating Trap, with relation to Ground Surface and Sewage Flow



Section of a Wash Down Closet



Dean's Gully Trap, containing a Moveable Bucket for the Delictus



Doulton's Combined Waste and Overflow for Bath

choice can be made should, as a rule, face the east or south-west, the morning sun in this way warming the front rooms, whilst the afternoon sun plays upon the back rooms. Bedrooms facing the north or north-east receive the morning warmth and are cooled by night. There can be little doubt that trees growing in too close proximity to a house favour dampness, as also does the growth of ivy on house walls. It has been found by experiment that ground covered by forests showed an average annual temperature of several degrees lower than that of the surrounding soil. This difference extended in the case of the forests to four feet deep, and was greatest in summer and least in winter. With reference to the prevention of damp in houses, the nature of the foundation is a matter of extreme importance. Where any suspicion of undue wetness of soil exists, what is known as a *damp course* is generally introduced into the walls above the level of the ground. The material used in making the damp course may consist of asphalt or slate embedded in cement, stoneware being also sometimes employed. The construction of ar area and of cellars or other underground apartments, in this sense, should also receive special attention by way of preventing any extension of damp to the lower apartments. In building the walls of houses many experts express an opinion in favour of hollow walls, these being separated at intervals by cross bricks, the idea represented here being that of attaining additional heat in winter and of coolness in summer. The porous nature of the bricks in the intervening wall space also serves to prevent the access of damp. Regarding the material used for building houses, this of course will vary according to the district in which they are built. Brick is, of course, very largely used in the construction of modern dwellings. But it should be noticed that as regards differences existing in the qualities of the bricks employed, they may be so soft and so porous that each brick may be capable of absorbing a pint of water. Hence the necessity for using a good quality of brick. Also, where soft stones are used for building in the case of towns, rapid wasting and decay of the stone takes place through the influence chiefly of the carbonic acid gas of the air. The Houses of Parliament in London illustrate a remarkable error of this description, the magnesian limestone employed in these buildings being gradually disintegrated under the action of the air of the city.

Rooms and Wall-papers.—With regard to the arrangement of rooms much depends in this case upon the class of house built, the size of the rooms, and the circumstances of the tenants. The plan of having carpets or rugs in the middle of rooms only, has much to be said in its favour, seeing that a room can be easily and conveniently

cleaned without serious disturbance of furniture. In such a case the sides of the floor are covered with linoleum or floorcloth, which is in its turn easily kept clean. With regard to wall-papers, a word may be said with reference to the selection of what may be called sanitary wall coverings. Paint can be used for certain rooms, but a much preferable preparation is that known as Hall's Washable Sanitary Distemper, made by Messrs. Sissons of Hull, which can be applied to walls in the easiest manner possible, and forms a smooth surface readily washed and cleansed. It is extremely durable, cheap, and, in addition, can be had in tints of any colour.

Wall-papers should be guaranteed to be free from arsenic, inasmuch as under the action of the heat of the room the arsenic becomes volatilised, and forms injurious compounds, which, when breathed for any length of time, give rise to symptoms of chronic arsenical poisoning. Such cases are marked by sore throat, irritation of the eyes, and general debility. It is a mistake to suppose that only papers of a green colour are liable to contain arsenic in their pigments. Papers of all colours, in fact, may be suspected. Our only safety in this respect is to obtain an assurance from the paperhanger that he, in his turn, deals only with wholesale firms who guarantee their papers free from all poisonous ingredients.

Water-Supply.—A most important feature in connection with the health of the home is that included in the question of water-supply. A pure water should have *no taste, no colour, and no smell.* It is true that under certain circumstances even the water-supply of a town may through imperfect filtration, after heavy floods, exhibit a slight amount of colour. This condition may be productive of no actual harm, still, drinking water should not exhibit any deposit, and should in the same way give off no odour and have no perceptible taste. Some of the most poisonous waters, in the sense that they have been thoroughly polluted with the germs of cholera and typhoid fever, have appeared clear and sparkling to the eye. Indeed, the presence in the ordinary drinking water of a large amount of gas should cause it to be regarded with suspicion. The water supplied to large towns may be regarded as of a healthy character. It is when such a water-supply, however, becomes affected at or near its source, say, by typhoid matter, that serious results may be produced. An epidemic of typhoid fever such as that which caused a large amount of illness and mortality at Maidstone, in Kent, some years ago, forms only one of numerous examples of such an occurrence. *Well-water* must always be regarded with a certain amount of suspicion, from the fact that wells which may be perfect in structure to start with, in course of time are liable to

exhibit defects, with the result that contamination of the water from the surrounding soil becomes possible. Where a country water-supply is derived from wells the water should be boiled before use, this remark also applying to water derived directly from rivers or allied sources.

Cisterns.—In many towns water is drawn directly from taps, and storage of water in the house is thus rendered unnecessary. Here we are dealing with a typical water-supply which ought always to be of a *constant character*. Where a town has *an intermittent supply*, the water being turned off for a certain number of hours each day, storage arrangements in the shape of *cisterns* have to be provided. The intermittent supply is not without its dangers, inasmuch as the empty pipes are liable to convey sewage gases into the water in the case of any defect existing in the drains. Where cisterns exist in a house for purposes of storage, these should be regularly cleansed by the plumber. In many cases cisterns are left uncovered, and in addition, even a fairly pure water is liable now and then to bring in deposits of mud which settle down in the bottom of the cistern and tend to form a very powerful source of pollution. Also, rats or mice may be found drowned in a cistern, and it need hardly be pointed out that the decomposing bodies of these animals are liable to give rise to serious illness in the shape of blood-poisoning. Considering that such diseases as typhoid fever, cholera, diphtheria, and in all probability dysentery also, are conveyed to us by water, the importance of securing a pure supply of this necessary fluid need not be further emphasised. The arrangements of the cistern also demand attention. An overflow pipe is provided, so that if the ball-cock of the cistern falls out of order, the overflow water escapes by the waste pipe. This waste pipe should be led directly out through the wall of the house (Fig. 78 B) and not carried, as is too often the case, into a drain (A). In the latter case sewage gases are liable to pass up the pipe and thus to infect the water

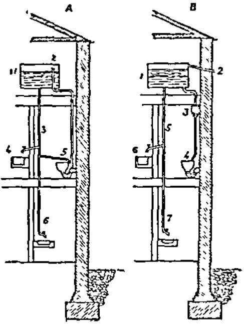


FIG. 78.—At A is shown cistern (1) with its overflow pipe (2) passing directly into soil pipe (5) [illegible]

Filters.—In cases where a water-supply is not above suspicion, as in the case of well-water already alluded to, many persons are in the habit of employing filters for the purpose of securing a pure supply. It should be clearly borne in mind that ordinary filters are not of the slightest utility in removing germs of disease from the water. They will remove the cruder and larger particles which tend to pollute the fluid, but they have no effect whatever in keeping back disease microbes. In addition it is very often found that filters are not regularly cleansed, and it need hardly be said that water coming through a dirty filter is much more unsafe to drink than ordinary

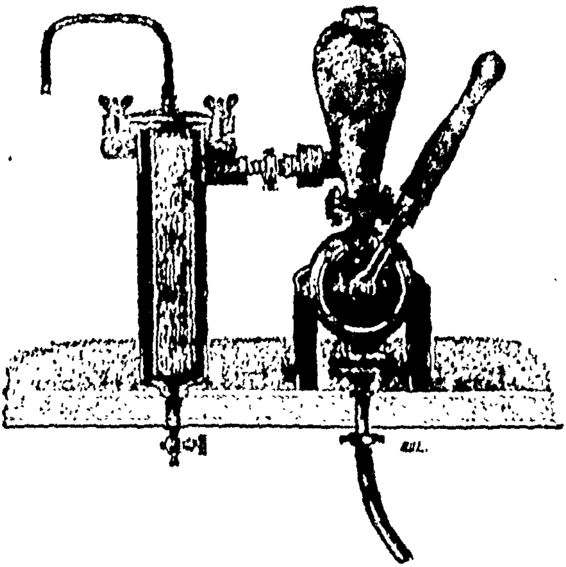


Fig. 79.—House Pump Berkefeld Filter, giving about 20 Gallons of Water per Hour. (One-tenth original size.)

unpurified water, seeing that in addition to the impurities of the fluid which it originally contains it is certain to acquire additional impurity from the filter itself. The only filters which can remove disease germs from the water are those of the *Berkefeld type* (Figs. 79, 80, and 81) such as are used in laboratories to render the water-supply absolutely free from germs and microbes of all kinds. The principle upon which these filters act is that of the mechanical purification of the fluid. A Berkefeld filter consists of a case, within which is contained the filtering medium known as a "candle." By pressure, the incoming water is forced through the pores of this "candle," this process removing all microbes it may contain, and affording a supply of absolutely germ-free water. Special varieties of these filters are made for use under various circumstances, ranging from the house

requirements to those of an army in the field. The cleansing of these filters, which from a period of from ten to fourteen days will act perfectly, is easily accomplished. The "candle" is taken out and boiled, this effectually sterilising it, so that it can be used again, whilst a supply of "candles" can be kept by way of alternating their use.

Drainage of the House.—The drainage of an ordinary town house presents us with an example of what is called the water carriage system. Under this term is naturally included the removal of sewage, through the flushing action of water. In country districts the closets

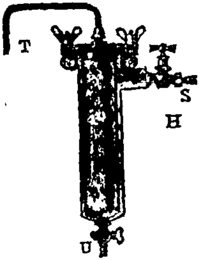


FIG. 80.—Berkefeld Filter fitted to House Pipe. S is the Inlet Pipe; U is the Flushing Tap; and T is the Outlet for the Filtered Water. The filtering "candle" is seen inside.

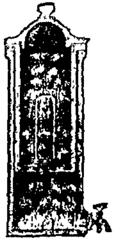


FIG. 81.—Section through Stoneware Table Filter (Berkefeld) showing Filtering Cylinder inside. This Filter is adapted for ordinary use without attachment to water pipes.

and drains of a house may empty into a *cesspool.* If this cesspool be properly constructed so that no leakage takes place into the surrounding soil, and if it be periodically emptied, no objection can be taken to its presence; only, too frequently, the cesspool is a neglected item, and it becomes a special source of danger when, in the event of other drainage arrangements being instituted, it may actually be built over, and thus come to constitute a very serious nuisance and disease-producing condition.

Closets.—With regard to closets in country districts, these often exist outside the house, and sanitarians recommend in such a case that the *earth closet system* should be adopted. Here a certain amount of dried earth (or it may be sifted ashes) is thrown

upon the refuse, such matter forming a very valuable manure. In the case of ordinary closets a word of warning should here be given against the old-fashioned type known as the *pan closet* (Fig. 82). This appliance derives its name from the fact that a pan exists below the basin of the closet itself, the basin opening into a receiver which rapidly becomes foul, especially if the flush of water is not of sufficient character. This type of closet is only fit for a museum of effete sanitary appliances. An American authority says of this closet: "It probably was not, although it might have been, an invention of the devil." Modern types of closets are known as "wash-outs" (Fig. 83; see also Plate). Each of these is supplied with the necessary flushing water from a special cistern, the amount discharged being regarded as sufficient to sweep away refuse matter. Valve closets are also to be commended as sanitary appliances, the mechanism in their case, however, being of a somewhat complicated description, and liable frequently to get out of order.

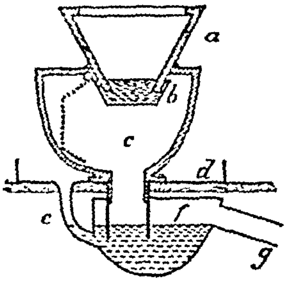


FIG. 82.—Pan Closet.
a Basin; *b*, Pan; *c*, Receiver or Trunk; *d*, Floor Line; *e*, Safe Waste Pipe; *f*, Trap; and *g*, Soil Pipe.

Healthy Drainage.—In the old system of house drainage the soil or discharge pipes of the house were carried directly down into the main drain or into imperfect traps (Fig. 87; see also Plate), and no means of ventilating the pipes was provided. To-day, with a better knowledge of sanitation, architects and plumbers provide such means of ventilating soil pipes so that houses may be regarded as sanitarily safe. Each discharge pipe passes into what is called a *ventilating or intercepting trap*, of which *Buchan's trap* (Fig. 86; see also Plate) is perhaps the best-known example. The principle of house drainage may be readily understood if we have regard to the arrangements through which an ordinary kitchen sink, taken in this case to represent the drainage of the whole house, may be rendered an effective sanitary appliance. In an imperfectly constructed sink the discharge pipe passes directly down into the drain (Fig. 84, A), therefore a servant engaged in her work over the sink is liable to inhale sewage gases passing up the pipe. In the proper method of construction the exit pipe is cut short, and is made to discharge either in the open air (into a trap) or passes into an intercepting trap in which an air opening exists (Fig. 85).

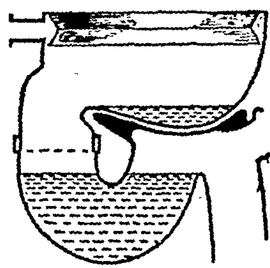


FIG. 83.—Wash-Out Closet.

We thus note that when sewage or refuse matter is not passing down the pipe, fresh air, instead of sewage gas, is passing upwards. If now we suppose in the case of any other house drain the free end of the pipe is carried upwards above the roof of the house, we provide an opening whereby any sewage gases can escape. A circulation of fresh air enters at the trap below and escapes at the summit by the pipe above (Fig. 84, B). On this simple principle sanitary drainage is being carried out to-day, and a vast improvement in

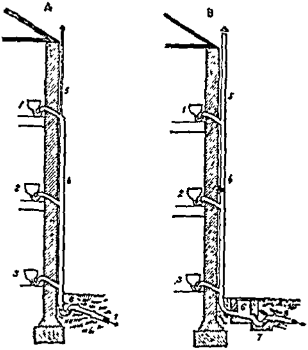


FIG. [illegible]

the health of the nation, and freedom from the attack of such a disease as typhoid fever or diphtheria is in this way secured.

Drain Tests.—With regard to *drain testing* this may be done in a scientific manner by the aid of what is called the "smoke test." Here smoke is pumped into the drains which have been previously blocked, so that if any leakage exists the smoke finds its way into the house. A simple test is that of using oil of peppermint. Two ounces of the oil placed in a pail of boiling water may be poured down the soil pipe at its highest point, this aperture being closed, or th mixture may be poured into a trap situated outside the house.

the pungent odour of the oil finds its way into the house, drain-leakage may be suspected. It is necessary, however, in using this test, that the opening down which the oil is poured should be covered over with wet cloths in order to prevent any odour from escaping, and that all windows and doors should be kept closed. It is also recommended that the person who pours down the oil should remain outside the house, seeing that his clothes are capable of carrying the pungent odour within.

Occupation and Health. — A few words are permissible regarding the subject of an individual's occupation or profession in relation to his health. What are known as *trade or industrial diseases* are affections distinctly recognised as being associated with certain insanitary conditions incidental to the occupations in question. Thus we find overcrowded workrooms and bad ventilation tending to induce the onset of consumption and other lung troubles. In the same way exposure to climatic influence, as in the case of outdoor workers, gives rise to like affections. More distinct, however, in its effect, is the inhalation of various kinds of *dust*, consisting of metallic or mineral matter, or such a substance as flax dust. The inhaling of injurious gases forms another source of disease. Interesting details have been compiled showing the relative mortality among persons engaged in various occupations. It is thus noted that if the comparative mortality figure for all males (and from all causes) between the ages of twenty-five and sixty-five be taken at 1000, we find the death-rate of inn and hotel servants numbers 2205. The figures for general labourers in London is 2020, for Cornish miners 1839, for file makers 1667, for cabmen and omnibus men 1482, for hairdressers 1327, for medical men 1122, and for tobacconists 1000. Below the mark we find blacksmiths set down at 973, coal miners 891, lawyers 842, grocers 771, teachers 719, gardeners 599, and clergymen 556.

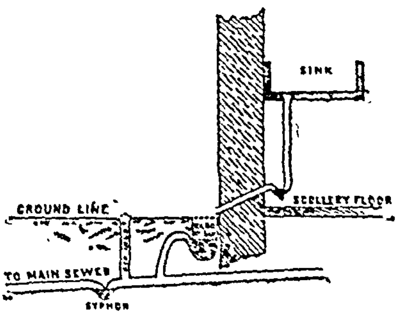


Fig. 85.—Kitchen Sink, perfectly disconnected from Drain, and opening into a Gully.

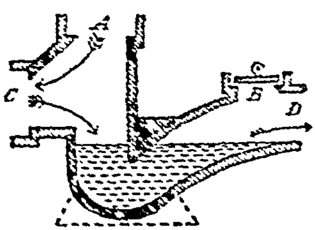


Fig. 86.—Plan of a Disconnecting Trap (Buchan's), showing Inlet from House (*C*); Ventilating Opening (*A*); Exit to Sewer (*D*) at other extremity of Siphon bend; and Inspection Opening (*B*).

In considering the causes of a high mortality in certain trades we have to take into account the conditions already mentioned, namely the circumstances under which these avocations are pursued.

Thus the grinders of Sheffield have long been notorious for a high mortality, due to their inhaling the fine steel dust flying off from the articles they polish. In the same way, and before a perfect system of ventilation was introduced into flax-dressing rooms in Belfast, the mortality amongst flax-dressers was extremely high. Coal miners of old recorded a large number of cases of "miner's lung," which practically consisted in a rapid form of consumption induced by the breathing of coal dust. This affection has, however, been much limited through the more perfect ventilation of mines. Matchmakers under the old system frequently suffered from what is called "phossy jaw," a term applied by them to the results of phosphorus poisoning, which acted upon the jawbones, inducing necrosis or death of the bone. A more curious example of an industrial disease is that known as *caisson* or *coffer-dam disease,* found amongst the men who work in the caissons used in the building of great bridges. These men work under a very high pressure of air, and certain curious symptoms chiefly affecting the nervous system are induced thereby.

Fig. 87.—The Dipstone Trap. An old and useless type.

Cures for Industrial Disease.—It is important to note that improvements in modes of manufacture are capable of limiting these diseases in a remarkable degree. By the use of masks of magnetic iron the grinders of Sheffield may be protected against the inhalation of metal dust. In the same way, by the exercise of scrupulous cleanliness, white-lead workers can save themselves from poisoning through the contact of lead with the skin. Matchmakers do not suffer from "phossy jaw" unless they are careless in returning to their work after the extraction of a tooth, and unless they pursue their work under circumstances calculated to afford the easy access of the phosphorus fumes to the jaw. Legislation has to-day very largely protected the workman and the workwoman from preventable accidents, but it certainly remains for the working-classes themselves to second the efforts of the sanitarians who have earnestly laboured on their behalf in recommending the means whereby they may be saved from the inroads of serious disease.

HEALTH RESORTS

Owing to the facilities of modern travel a new phase of health science has been inaugurated in respect of residence at certain places where not only the conditions of healthy existence are typically represented, but where special means may be used for the cure of certain

diseases. Such places are typically known as *health resorts.* They vary materially in their character. Some of them owe their celebrity simply to the natural purity of their surroundings, such conditions being represented by climate, soil, and other phases. On the other hand many resorts derive their importance from the fact that they offer special means adapted for the cure of disease, such means being employed along with the favourable hygienic conditions presented by the resort itself. An ordinary seaside place or an inland country district may be held to represent resorts of the first class; whereas the second variety of resorts is represented by places celebrated, it may be, for the presence of certain kinds of *mineral waters* adapted to act powerfully in the case of certain ailments, or through the establishment of *baths* of various kinds, ranging from ordinary warm baths to those containing a large quantity of brine or salt, such baths being specially adapted for the cure of rheumatic conditions.

Regarding health resorts generally in Great Britain at large, the general rule that east coast resorts are bracing, whilst western resorts and south-western resorts are of a more relaxing character, expresses fairly the climatic conditions represented. In the case of inland resorts the particular effects they are calculated to produce depend very largely on their elevation above sea-level, and also to the character of the surroundings. Resorts which are situated in a valley are found to be of a relaxing character, whereas those which are placed in a more open situation, commanding a freer atmosphere, may be regarded as of a bracing nature.

Seaside Resorts.—With regard to *seaside resorts* a feature of these places is found in the fact that a more equable temperature is experienced at the coast than inland. Physicians regard a residence at the seaside to favour greater activity of the bodily processes, and thus to stimulate the nutrition of the body. Thus in many cases of debility, the seaside forms the typical resort. On the other hand persons who do not require their processes of nutrition to be hastened, so to speak, are regarded as more suitable subjects for inland resorts and for those placed at a considerable distance above sea-level. A physician, dealing with the difference between seaside and inland resorts, remarks that people of a highly irritable nervous organisation will benefit more by mountain air than by sea air; while, on the other hand, those who do not exhibit such nervous symptoms, and who therefore can withstand the stimulus given to their nutrition, will probably find the seaside a much more preferable ground for recovering health. With regard especially to the curative powers of the sea, we ought to bear in mind that cases of debility, especially of a *scrofulous type*, may recover from a seaside residence, and more especially from a stay

at a bracing resort. Margate, on the Kentish coast, for example, enjoys a high repute in this respect, but it is highly probable that very much the same effects would be produced by any other East Coast resort, and more particularly those which have a free exposure to the ocean air. In addition, we have to take into account that sea air contains, like mountain air, a large amount of *ozone*, which, as has been already explained in the section of this work dealing with the atmosphere, represents oxygen in a highly electrified condition. Also the purity of sea air, owing to the absence of germs and other forms of organic matter, must be borne in mind in considering its effects on invalids subjected to its influence.

Mineral Waters.—With reference to the existence of *mineral springs*, it is wonderful to note how, in many cases, the presence of a particular mineral in a spring has developed a small village into a most important town. This is especially true of many Continental resorts. Various kinds of waters are used for the cure of disease. In the first instance, ordinary water may issue from springs in a hot condition; hence we obtain ordinary hot baths. Alkaline waters, containing soda, potash, or like minerals, form a second class; allied to them being salt waters, containing a valuable proportion of saline ingredients. Another important class is that known as iron or chalybeate waters. Then, in addition to these, we find waters containing sulphur, and lastly, waters which are notable for containing a large proportion of limy and earthy material. In England, the simple thermal or hot waters are found chiefly at Buxton and Bath. Abroad they are represented at such places as Ragatz, Wildbad, Gastein, and other resorts. Such waters are adapted for nervous cases and irritability of the nervous system at large, whilst occasionally they are applied to the cure of gout and rheumatism. In the case of waters containing salt and useful in rheumatism, these in England are chiefly found at Droitwich, Saltburn, and Woodhall. The waters of Winchester and Leamington also contain salt, whilst abroad, Kissingen, Homburg, Wiesbaden, Baden-Baden, and Salins represent such resorts.

Alkaline waters are found in such places as Vichy and Mont-Dore; other waters of this character being Apollinaris, Ems, and Rosbach. Such waters have the power of curing digestive ailments, and also inflammatory affections of the lungs and other organs. Iron or chalybeate waters are found at Tunbridge Wells and Harrogate in this country. Abroad they are represented by such places as Spa, Schwalbach, Pyrmont, and St. Moritz. Iron waters are generally regarded as of a tonic description, and are frequently employed in many cases peculiar to women. Anæmia and like disorders are also

treated by their aid. Sulphur waters occur in Great Britain at Moffat and Strathpeffer; whilst abroad, Weilbach and Baden, in Switzerland, Aix-les-Bains and Aix-la-Chapelle represent resorts of the type in question. These waters are prescribed by physicians for congestion of the liver, for certain affections of the lungs, and for chronic rheumatism; whilst at Aix-la-Chapelle they are employed in the treatment of syphilis. Earthy waters are distinguished by containing compounds of lime and carbonate of magnesia. They are used for the cure of dyspepsia and diarrhœa, and also in certain bladder troubles. Contrexeville is one of the best known of this class at these resorts. In addition to the waters already named, what are known as sulphated waters are distinguished by containing sulphates of soda or magnesia, whilst certain waters contain both classes of substance. They are classified into bitter waters and alkaline sulphated waters, the latter containing carbonate of soda and common salt. Such waters as Püllna and Hunyadi Janos represent this class of springs; whilst Carlsbad and Marienbad are the best-known resorts where waters of this type can be naturally used. These waters are chiefly taken on account of their aperient action. It is not necessary, in the present instance, to mention holiday resorts in detail, and the reader may therefore be referred, in so far as the special description and characteristics of any given resort are concerned, to the manuals which specially deal with the characteristics of places where the cure of disease is practised, or where residence for a holiday season is calculated to produce good effects.

The Disposal of the Dead.—Hygiene does not concern itself alone with the care of the living body. It extends its scope to include the subject of *the disposal of the dead,* with reference to the safety of the living. The subject of burial is in its way one of great importance. Modern opinion has condemned what is known as "intramural interments," or, in other words, the practice of interment within the bounds of cities. Hence, for some years past, it has been the practice to lay out grounds for cemetery purposes on the outskirts of towns. We may note to-day the futility of any such proceeding in so far as the removal of the dead from the precincts of the living is concerned. For cities and towns tend to increase and grow, and we are therefore met by the spectacle of cemeteries which, once exisiting outside the boundaries of a town, are now surrounded by dwellings.

When we have regard to the process of ordinary burial, we discover that it must be roundly condemned as an insanitary procedure. The object of ordinary burial is that of placing the dead body in the earth, in order that the soil may promote its ready and inoffensive decomposition; that is to say, its resolution into such matters as

carbonic acid, ammonia, and other waste products. Assuming that a human body is placed directly in the ground, and is allowed to come directly in contact *with soil of a proper description*, we may assume the process of burial in such a case to be typically represented. But in modern civilised life such a practice is not carried out in any sense. The dead body is enclosed in a coffin, frequently of massive description, the coffin itself being often lined with metal, so that the access of the earth to the body is in this way prevented. Again, the practice of interring bodies in vaults, and of practically preserving them, cannot be said to represent burial at all. In the practice of modern burial we thus find an insanitary state of matters represented, in that decomposition of the body must be retarded for a long period owing to the slow decay of the coffin. Mention need here be made, also, of the waste of money which is represented by the garish funeral displays to which we are only too well accustomed, an elaborate and highly decorated coffin being made, only to be placed in the ground, where, until it rots, actual decomposition of the body cannot take place.

Insanitary Burial. — Yet another point condemnatory of ordinary burial must be noted. The soil in which burial takes place becomes a question of the utmost importance. If the soil of a burying ground be unsuitable, bodies are preserved therein instead of being decomposed. In wet soil particularly, preservation of corpses tends to take place. The typical soil for burial would be a dry and loamy soil, but as we have seen the body should be placed directly therein, and not protected from the influence of the surrounding earth by coffins of various kinds. Evidence regarding the terribly overcrowded nature of cemeteries, and the awful revelations of the paupers' pit of burial grounds (the *fosse commune* of the French), where coffins are piled upon one another without intervening earth, are more than sufficient to disgust the mind with the practice of burial as ordinarily carried out. Therefore we must reject burial as to-day practised as a proper or reverential mode of disposing of the dead, seeing that the conditions which are implied in the process are not at all represented in modern civilised life. Sir F. Seymour Haden proposed a reformation in the shape of wicker coffins, so that the body enclosed in one of these receptacles can be placed directly in contact with the earth. This no doubt would serve to remove one of the objections to ordinary modes of interment, always provided a proper soil is obtained. Beyond the objection to the coffin as preventing decomposition, we have, however, to consider the difficulty in many cases of acquiring a suitable soil.

Cremation.—It was due to the energy and far-seeing intelligence

of the late Sir Henry Thomson, Bart., M.D., that another mode of disposing of the dead was prominently brought before the notice of the British public. This mode of procedure is known as *cremation*. By aid of a specially constructed furnace which may either be heated in the ordinary fashion, or, as in a recent French development, by means of gas, a human body can be disposed of in from an hour and a quarter to an hour and a half, leaving behind only about one and a half pounds of ashes in the shape of bone fragments. These ashes reverently gathered up, can be placed in an urn for preservation, or may be buried. This process is unattended with any nuisance in the shape of odour, and the silent action of the cremating furnace may therefore be regarded as a typical means of disposing of the dead. Crematoria have been already constructed in many large centres in Great Britain. There are many in America, in France, in Italy, and in other countries. The original English crematorium is that still in existence at Woking in Surrey, but a large crematorium has recently been built in the north of London at Golder's Green, where every facility for the disposal of the dead is provided. Crematoria have also been constructed at Manchester, Liverpool, Leeds, Bradford, Hull, Darlington, and Glasgow. There can be little doubt that as the public realise the immense advantages presented by cremation over any other form of disposing of the dead, the practice will become universal.

The Argument for Cremation.—The advantages of cremation may be summed up by stating that it disposes of the dead in a manner which prevents any injury to the living in the shape of possible contamination of air, water, or soil. In the next place it obviates all the difficulties connected with the question of suitable soil required for ordinary burial, and does away with the presence of masses of putrefying material which are bound to accumulate under the ordinary system in the neighbourhood of the abodes of men. In the third place valuable ground now occupied by masses of decaying corpses would thus be rendered available in the future for building or other purposes, just as many of the old churchyards of London have been converted into beautiful gardens and open spaces. Finally, various objections have been urged to the process of cremation. There is the sentimental objection which arises from the idea that to consume a body in a furnace in some fashion implies a want of reverence for the dead. One might well argue that wherever sentiment exists as regards burial, it must stop at the grass growing on the grave, for there can be little sentiment involved when by aid of the mind's eye we penetrate below the surface of the soil and think of the mass of decomposing mortality below. Another objection which has been urged

against cremation is found in the statement that the cremation of a body would effectually prevent any subsequent tracing of a crime, represented, say, by a case of poisoning. This objection is of no account whatever, and can only be urged by those who are unacquainted with the careful precautions taken to ensure that the exact cause of death is ascertained before cremation is permitted. Under the present system of burial many crimes undoubtedly escape detection, but when it is noted that no body can be accepted for cremation without a definite certificate of death in the first instance, and, in the case of doubt, the production of a second certificate (as the result of a post-mortem examination), it will be seen that the criminal has much more reason to fear the adoption of cremation than the present system of disposing of the dead.